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DISPLACING WELSBACH STREET LAMPS BY TUNGSTENS.

Competition continues sharp between the Welsbach gasoline lamp and the tungsten electric incandescent in the field of minor-thoroughfare illumination. In progressive cities and towns there is arising a genuine public demand for better lighting of streets located outside the central areas of heavy traffic, and nothing supplies this service as well as electricity, when all the factors are duly considered. In its maintenance of candlepower the tungsten lamp is far superior to the mantle running on gas or combustible vapor, and in addition, the simplicity and reliability of the electrical equipment are strong talking points easily backed up by experience, when the central-station man appears before the municipal council board. Nothing is quite as suggestive, however, as an actual test in the field, and a recent investigation of the comparative efficiency of incandescent and Welsbach-gasoline street lighting at Worcester, Mass., furnishes convincing evidence of the superiority of electricity in the illumination of subordinate thoroughfares. In the lighting of main streets and avenues electricity has practically no competitor in this country, but its effectiveness and economy in subordinate illumination are not as well appreciated as ought to be the case.

The street-lighting service at Worcester is supplied by the local electric lighting company, but a so-called municipal street-lighting department maintains a close inspection of the illumination, hours of operation, costs, and general conduct of affairs, on behalf of the city. It has been the policy of the city for many years to light evenly all streets where the service has been established, and as a result of the care taken in this direction few cities in America are so uniformly illuminated. The standard of illumination may be somewhat lower than perfect satisfaction demands, but it is maintained over the entire territory which the city attempts to cover, a condition which is anything but common in the street-lighting practice on this side of the ocean. It will be an easy matter to raise this general standard, if necessary at any time, the only consideration being that of additional expense.

To determine the comparative value of different types of street lights, a circuit of seventy-five-watt tungsten lamps was recently installed by the Worcester Electric Light Company, and several of the largest street-lighting contractors in the

country invited to erect sample gasoline lamps for competitive test. The location in which these tests were made provided an excellent range of street conditions as regards travel, shade, exposure, and color of the road, and readings were taken by the mayor, members of the committee on street lighting and the superintendent of the department. The mean reading of the entire number of lamps tested showed an effective radius of 89.3 feet for the gasoline lamps of one company, 67 feet for those of another company, and 124 feet for the tungsten electrics, the higher candlepower of the Welsbachs being offset by the reflector used on the tungstens, which was arranged to throw the entire light of the lamp below the horizontal, to the surface of the street, where the light is most needed.

The first company offered to sell the installation already in position for $15 per post; without burners the bid was $10.50 per lamp-year, and the contract bid was $17.50 per lamp-year. The second company offered to sell for $16.50 per post, to lease for $12 and to maintain for $18.30 per lamp-year, all offers being for a three-year term, the lamps to burn every night. The acceptance of the Welsbach bid under the first proposition would have required the city to invest $30,000 for stables, horses, wagons and lamp equipment in the streets and to meet a maintenance cost of $28.30 per lamp-year. The second proposition could have been handled in either of two ways, the first of which would have required an investment of $10,000 and a lamp-maintenance cost of $30.36 per year. The second way would have taken the city back to the old system of a number of contractors, each of whom would furnish his own team, boys, etc., at an expense of $31.80 per lamp-year. The estimated cost of service under the third proposition was $26.50 per lamp-year. The local electric light company offered to provide service with seventy-five-watt tungsten lamps identical with those tested for $23.50 per lamp-year of 4,000 hours' burning. This enabled the city to use a lamp having thirty per cent greater street value at a cost of $3 per year less than the competitive gasoline plan. The electric lighting company's offer was accepted for a trial commercial installation of about 300 tungstens, with the idea that if the installation proves satisfactory it will ultimately be extended over the entire city, outside of a radius of two miles from the business center. While the results of this final test have not yet been announced, there is little doubt that electricity will be found entirely successful and will displace gasoline mantle lamps throughout the entire outlying sections of the city. From every point of view the use of gasoline mantle lamps in urban street lighting, with its attendant train of maintenance costs based on the horse-drawn wagon and boy method savors of the Dark Ages in more senses than one. It is a source of general satisfaction that electricity should be coming into its own to such an extent in a city like Worcester, which has a conservative reputation for a town of 150,000 inhabitants. The importance of selecting good reflectors in street lighting is apparent from the above tests and it is worth noting that the distribution of light is a more vital consideration than the total flux produced at the lamp.

ELECTRIC CAR LIGHTING.

The study of effective and efficient methods of illumination which has been fostered to such a great extent by the Illuminating Engineering Society is at last making an impress upon the lighting of railroad cars, as was very forcibly brought out by the paper of Mr. Charles R. Gilman before the recent meeting of the Chicago Section of the Society.

The first installations of electric lighting in railroad cars seemed to have for their object one of two extremes—either the furnishing of the least amount of light that could be considered sufficient for the purpose or else the flooding of the car with most profuse illumination regardless of its suitability for use or of the comfort of the passengers.

In recent months, however, a number of the railroad companies have been making efforts to provide illumination which shall be comfortable, adequate and efficient. The use of metal lamps has been widely extended and this has resulted in a great improvement in efficiency. The placing of the lamps in the cars is also being better regulated and this, with the proper choice of units, serves to adapt the illumination better to the purpose for which it is required. The use of shades in conjunction with the proper choice of units and position has, finally, resulted in greater comfort to the passengers. It has been claimed and probably with good reason that much of the discomfort experienced by railroad passengers on long trips, such as headache, nausea, etc., is due to the presence of incandescent lamps mounted so that they cannot well be excluded from the field of vision. Combined with a superfluous quantity of illumination, this may well, when continued for hours, have had very definite and undesirable effects upon the passengers.

The head-end system of supplying current to the lamps from a generator in the baggage car has shown itself to be less expensive than the axle-driving system, and it also provides a steadier voltage. The drop in voltage with the latter, when the load falls on the storage battery, is generally noticeable and sometimes very excessive, and this system is responsible for many poor installations.

On the other hand, unless a storage battery be carried in each car, the head-end system makes no provision for lighting a detached car, and to provide for such contingencies it is necessary to carry gas or oil lamps.

We still see many examples of poor illumination upon railroad cars and we may expect to do so for some time to come, as it will require some experimentation and quite a little time to decide upon the best arrangements and to fit all the cars in service with them. It is encouraging, however, to find that very good work has been accomplished in this direction and that steady progress may be looked for in the future.

OIL FUEL FOR CENTRAL-STATION SERVICE.

The advantages of using fuel oil in modern steam plants accessible to large and cheap supplies of this product are well known to central-station managers operating systems in the West and South. The extension of this practice into regions which have for many years been given over almost entirely to the use of coal, presents a new development in the problem of economical power production and warrants a consideration of the conditions under which fuel oil may profitably be applied to central-station service. At a meeting last week in Boston, Mr. Bertrand R. T. Collins presented a valuable paper upon this question, based upon a wide experience with southwestern plants of Stone & Webster supplying electricity to railway, lighting and power customers, and an adaptation of this type of fuel to a number of factory plants in New England, with the prospect that to some extent coal may be superseded in the near future in the central-station field itself.

Speaking from the standpoint of the consulting engineer, the author pointed out the advantages and limitations of fuel oil for central-station service, showing that where it is desirable to use it, the question of transportation cost is greatly simplified if water hauls are possible. In New England in particular the price of coal tends to advance more or less regularly. The cost of fuel oil in New England has been decreasing recently so that at present it can be purchased there more cheaply than in Western Texas, on account of the low cost of water transportation compared with the expense of rail shipments in tank cars. The largest tank steamers have a capacity of 100,000 barrels each, containing the heat equivalent of 25,000 tons of the highest grades of coal.

Included in the class of stations which may profitably consider the use of fuel oil are plants where the cost of handling coal by ordinary methods is higher than the average because of local conditions, and where the installation of suitable coal-handling equipment would not be warranted by the saving effected. Thus, a plant located on navigable water, but with the channel at a considerable distance from the shore, would require expensive wharves, docks, coal-pockets and equipment to enjoy the benefits of mechanical coal-handling by water routes, and a similar large expenditure is required where a plant is located some distance back from the water front, and upon a relatively high elevation. In either of these cases, oil can be delivered to storage tanks outside the boiler room for the cost of a pipe line and the power required to pump the fuel from the barge into the storage tank; the barge being made fast to a few piles at the edge of the channel when unloading at a distance from the shore. Again, plants where boilers are hand-fired, and where more than one fireman is required per shift, and plants where greater capacity is required than can be obtained with the available coal, may profitably consider the oil question. With oil, thirty-five per cent or more additional capacity can be obtained than with high-grade coal. Oil fuel also gives added boiler capacity without increasing the stack capacity, and it completely solves the smoke problem. The absence of deterioration in storage, economy of space compared with an equal weight of coal, reduced boiler-room temperature, reduction in heat losses up the stack, improved diffusion over metal surfaces, tending toward longer wear, absence of dirt and perfection of control in case of emergencies, are well known. The disadvantages are that fuel oil has a low flash-point, requiring careful handling to secure the best results; that the ordinary underwriters' requirements are that storage tanks must be located underground and at least thirty feet away from the power-plant building —a condition frequently absolutely prohibitive in congested city districts; and the fact that with boilers using feed water of considerable scale-making qualities, the cost of repairs is likely to be increased by changing to oil, owing to the intense temperature developed in the furnace. With a proper setting for burning oil, repairs due to overheated tubes or surfaces should be less than with coal, however, unless the feed water is very bad.

These considerations point to the importance of thorough investigation before selecting either fuel oil or coal for permanent service. The smaller central station is particularly in line to be interested, however, in fuel-oil developments, since it is in the great majority of cases handicapped by high cost of fuel, and often by generating apparatus of only moderate efficiency. The losses due to banking fires at periods of no load are sometimes serious in small coal-operated central stations, and there is no question that the instantaneous control of firing possible with liquid fuel is a factor of large importance in the ultimate economy of plants of very limited size using oil fuel and supplying their customers with night service only. In large plants having conditions of service favorable to the most economical use of oil the results are most suggestive. Probably the most representative installation of this kind in the country is the Redondo plant of the Pacific Light & Power Company, in California. A recent test of this plant extending over seven days and now for the first time made public showed that an average boiler efficiency of 80.47 per cent was realized, the water evaporated per pound of oil from and at 212 degrees Fahrenheit being 15.23 pounds, and the heat value of the oil 18,281 British thermal units. The average CO_2 was 13.2 per cent, the excess air 21.2 per cent, and steam used by burners 2.15 per cent. The maximum efficiency obtained was 83.3 per cent, this figure having been secured when running the boiler (a 604-horsepower Babcock and Wilcox) at 109.2 per cent of its rating.

There can unquestionably be but little doubt that the important problem of fuel supply for small central stations will be considered from this point of view in many localities in the near future.

Board of Patent Control Abolished.

The board of patent control, having jurisdiction over certain patents of the General Electric Company and Westinghouse Electric & Manufacturing Company, will be dissolved on May 1, as the agreement under which the board was established expires on that date. This agreement was entered into in 1896 and provided for the pooling and joint use of certain patents owned by the two companies and was to run fifteen years. Now an arrangement has been entered into by which these companies are licensed to use each other's patents, and therefore the continuance of the pool has become unnecessary. The board consisted of C. A. Coffin and F. P. Fish of the General Electric Company and George Westinghouse and Paul D. Cravath of the Westinghouse Electric & Manufacturing Company, and E. B. Thomas. W. J. Jenks was secretary.

Lamp Association Dissolves.

The Association of Licensed Manufacturers of Incandescent Lamps against which the Attorney-General of the United States brought suit in the United States Circuit Court for the Northern District of Ohio, has dissolved. This association manufactures lamps under patents of the General Electric Company, which as licensor, it is alleged, has heretofore fixed the prices, terms and conditions under which lamps covered by patents owned by it are manufactured and sold. The companies involved in the dissolution are as follows: General Electric Company, Westinghouse Electric & Manufacturing Company, Westinghouse Lamp Company, National Electric Lamp Company, Aetna Electric Company, American Incandescent Lamp Company, Banner Electric Company, Brilliant Electric Company, Bryan-Marsh Company, Buckeye Electric Company, Capital Electric Company, Colonial Electric Company, Columbia Incandescent Lamp Company, Economy Electric Company, Franklin Electric Manufacturing Company, General Incandescent Lamp Company, Independent Incandescent Lamp Company, Kentucky Electric Company, Liberty Electric Manufacturing Company, Munder Electric Company, Standard Electric Manufacturing Company, Sterling Electric Manufacuring Company, Sunbeam Incandescent Lamp Company, Warren Electric Specialty Company, Gilmore Electric Company, Fostoria Incandescent Lamp Company, New York & Ohio Company and Shelby Electric Company.

These manufacturers will continue as licensees of the General Electric Company, but the formal association is discontinued.

Entertainment Features at the N. E. L. A.

At a meeting of the Entertainment Committee held on April 18 under the chairmanship of Arthur Williams, considerable progress was made with regard to the entertainment of the delegates and visitors at the National Electric Light Association convention in New York City, May 29 to June 2. Several arrangements have still to be completed and will be announced later.

The opening reception on Monday evening, May 29, will be of an original character in the nature of a promenade concert at the Hotel Astor, with a concert in the Roof Garden and Belvedere and dancing in the main ball room.

Another evening will be devoted to a theater party, for which three of the largest theaters have already been engaged, making provision for not less than 3,000 people.

During the week there will also be a ball game between a team of the Brooklyn Edison Company or the New York Edison Company and a team of the Philadelphia Electric Company. There will also be an afternoon tea for ladies at the Plaza Hotel and probably a morning concert, as well as provision for automobile rides to points of interest in the vicinity. For those who play golf, provision has been made at six of the metropolitan links to which free access and free transportation will be furnished.

A meeting and dinner of the Sons of Jove will be held at Coney Island on Friday evening.

On Saturday, which is a non-official day, the local operating companies will make guests of all the delegates who remain and will take them on a steamboat on a tour of inspection of the largest generating plants on Manhattan Island, including also the huge one of the Consolidated Gas Company at Astoria. During the afternoon, after the inspection, a trip will be made up the Hudson and in the evening a landing will be made at Dreamland, Coney Island, at an hour which will permit the visitors to see the brilliant and spectacular illumination of that famous seaside resort.

National Electric Light Special Train From St. Louis to New York.

An all-steel limited special train will be run from St. Louis to New York City, for the accommodation of the members and guests of the National Electric Light Association attending the convention, which is to be held in New York, May 29 to June 3. This train will be run over the Pennsylvania Railroad, leaving St. Louis on Sunday, May 28, at 12:30 p. m. It will be one of the Pennsylvania Railroad Company's most luxurious trains. The Central Passenger Association has granted a rate of a fare and three-fifths for the round trip on the certificate plan.

F. N. Jewett, of the Wagner Electric Manufacturing Company, St. Louis, Mo., is assistant master of transportation for the National Electric Light Association, and reservations can be made through him. As it is important that reservations be made early, those desiring accommodations on this train are requested to communicate with Mr. Jewett at once.

National Electric Light Association Membership Exceeds 7,500.

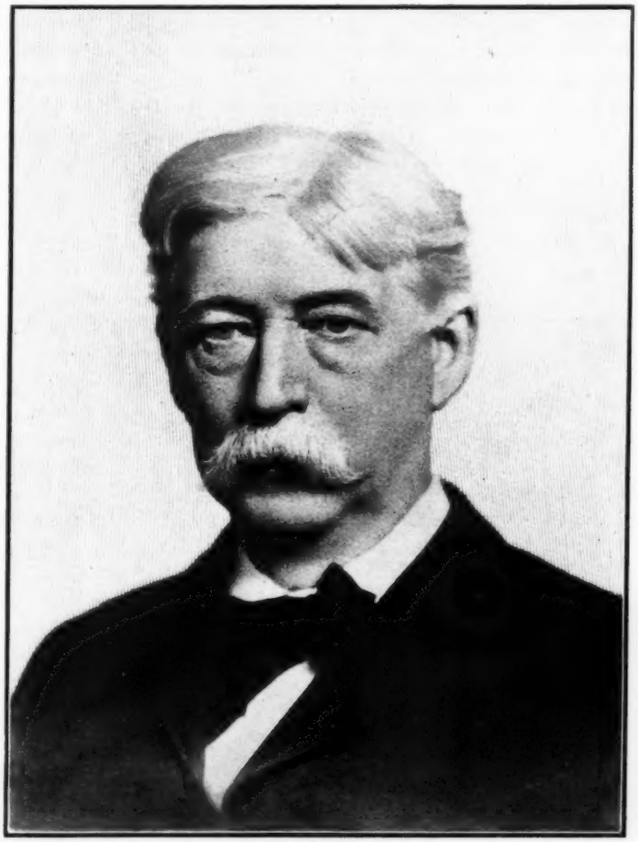
On April 18 the National Electric Light Association again attained a higher mark in membership, the total of that day being 7,521. In July, 1909, the membership was 3,135, and at the annual convention in St. Louis last May it was 5,520. The increase during the current Association year has, therefore, been already in excess of 2,000 and the indications justify the belief that by the time of the annual convention next month even the very large growth of 1910 will have been exceeded and that a total of 8,000 members will be reached. The growth is due to a variety of causes and the new list given in the Association's *Bulletin* this week not only includes several central-station companies but large lists from newer company sections, such as those in New York, N. Y., Joplin, Mo., and Pittsburg, Pa. At the present moment company sections are being organized at Scranton, Pa., and Birmingham, Ala., and these are expected to be in operation before the end of the month. It would appear that the Association has now become the largest electrical society in the world but the officers expect confidently that in another year the membership will be not less than 10,000.

Thomas B. Doolittle.

In the early days of the telephone, the art suffered greatly from many crudities. The scientific toy was the butt of a good deal of ridicule and a man needed to be possessed of courage as well as foresight in order to carry out any determination of making a commercial application of the speaking apparatus. One of the difficulties of securing good transmission was the poor talking qualities of the transmission line. For spans of any considerable length iron wire of course was used. The ordinary copper wire, too soft to maintain itself on long spans, had been found impracticable and this was considered a serious drawback considering the superior conducting qualities of the ordinary copper rod.

Thirty-four years ago experiments were begun on a process of drawing copper wire without annealing, so as to increase the hardness of the outer skin and thus improve the tensile strength of the conductor. The story of hard-drawn copper wire as told by Thomas B. Doolittle, to whose genius and perseverance the process is due, will be related in another issue.

Thomas Benjamin Doolittle was born at Waterbury, Conn., on June 30, 1839, the son of Benjamin and Betsey C. (More) Doolittle. He was educated at Woodbury Academy. In early life he was a manufacturer of brass articles. He says himself that at the age of eighteen he abandoned a position in New York City for the reason that he saw no satisfactory future, and by the advice of a friend cast about to learn and become an expert in a good trade. He took a position with his brother, a skillful mechanical engineer in the brass mill and wire works of Wallace & Sons, Ansonia, Conn. He later entered the manufacturing business as president of the company and in the early seventies became interested in electrical matters to some extent and joined in the organization of the Bridgeport Social Telegraph Company. In connection with his manufacturing he made many inventions, notably in the production of barbed wire; he was the originator of the buffer platform and coupler, of which modified types are in general use on passenger cars; he originated the first telephone switchboard, the telephone call-bell, and originated and placed in use the first fare-registering device on street cars. Upon the organization of the American Telephone and Telegraph Company in 1885, Mr. Doolittle was made vice-president. This position was tentative, however, and he soon resigned to resume work on broader lines of development. He received the Edward Longstreth medal from the Franklin Institute of Pennsylvania, in 1898, for originating the process of producing hard-drawn copper wire and he received the degree of Doctor of Science from Dartmouth College in 1909.



THOMAS B. DOOLITTLE.
Engineer and Inventor.

He is a member of the Franklin Institute, the American Institute of Electrical Engineers, and of the St. Botolph, Papyrus (Boston) and Players (New York) Clubs. Mr. Doolittle married Mary Louise Bradley, of Ansonia, Conn., December 24, 1866. He is known to telephone men throughout the country and is esteemed by a host of close friends and acquaintances as a gentleman of the most genial and courteous disposition and a scholar of profound knowledge and culture.

Magnetic Constants.

At the meeting of the French Physical Society on March 3, a paper was presented by P. Weiss and G. Foex describing some experiments upon the magnetic properties of ferromagnetic materials at temperatures above that of transformation. If T_0 is the temperature of transformation, and I the coefficient of magnetization,

$$I\ (T-T_0)=C$$

according to Curie. The experiments were intended to test the validity of this law, and to determine the values of the constants, C and T_0. Iron, magnetite, nickel, cobalt and nickel-steels were tested. When the reciprocal of I is plotted against temperature, the result is a broken line, whose straight portions each cover a considerable interval of temperature, and each gives a different value of the constants.

Government Power-Site Withdrawals.

Four new water-power-site withdrawals, embracing 7,549 acres, were made by the Federal Government during the month of March as a result of the field investigations of the United State Geological Survey.

A total area amounting to 1,400,571 acres now stands withdrawn for power purposes distributed as indicated in the following table of states:

	Acres.
Arizona	107,550
California	53,689
Colorado	204,583
Idaho	231,698
Minnesota	3,619
Montana	126,047
Nevada	15,375
New Mexico	9,706
Oregon	161,177
Utah	347,252
Washington	80,386
Wyoming	58,889
Total	1,400,571

Meeting of Electric Vehicle Association.

At the monthly meeting of the Electric Vehicle Association of America, held in New York City on April 25, R. C. Lanphier, manager of the Sangamo Electric Company, read a paper on "The Ampere-hour Meter for Electric Vehicles." By the use of lantern slides the construction, operation and use of these meters was described. A most interesting discussion followed in which Messrs. Kennedy, Russell, Bradshaw, Knowles and Lloyd participated. The secretary announced an electric vehicle parade in New York City about June first. Twenty-nine new members have been added since the last meeting making the total membership now 181. Charles A. Littlefield, of the New York Edison Company, presided.

A description of the meter, which formed the substance of Mr. Lanphier's paper, will be found in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 18, 1911, page 357.

Pittsburg Section Banquet.

The Pittsburg Section, American Institute of Electrical Enginers, held its third banquet Saturday evening, April 22 at the Rittenhouse. About 190 members and their friends were present.

Chairman Muller made a short address presenting the toastmaster of the evening, Past-president Charles F. Scott. Toasts were responded to as follows: "The Engineer of the Future." by H. G. Prout; "The American Institute of Electrical Engineers," by President Dugald C. Jackson; "A Word in Due Season," by J. Leonard Levi, D. D.; "Industrial Opportunities," by Robert Kennedy Duncan.

At the meeting on May 9 W. Edgar Reed will address the meeting upon "The Cost of Electrical Power Generation," with special reference to incandescent and arc lighting.

Utah Society of Engineers.

The annual dinner of the Utah Society of Engineers was held at the Commercial Club, Salt Lake City, Thursday, April 20, 1911. Addresses were made by President John Dern of the American Mining Congress and by various members of the society. The following officers were elected to serve for the year 1911-1912. President, M. D. Grosh; first vice-president, C. F. Moore; second vice-president, E. H. Beckstrand; secretary, R. B. Ketchum; treasurer, A. S. Peters.

Car Lighting Club.

A meeting of the Car Lighting Club was held on the evening of April 19, in the rooms of the Press Club of Chicago. After the customary dinner, D. J. Cartwright, of the Lehigh Valley Railroad, presented a paper on "The Cost of Car Lighting and How It Should Be Figured." This paper took up the question of proper accounting of the costs of electric lighting of railroad trains, particularly by the axle-driven system. The speaker advocated the classification of the accounts into four sections: Original investment and betterments, wrecks, maintenance, and transportation.

Among those participating in the discussion were Messrs. Farrelly, Hutchinson, Bohn, Cravens, Fisher, Sweet, Janson and Cartwright. It was recommended, in reporting on maintenance costs, that no account be taken of depreciation, interest on investment, and haulage. In comparing different systems, however, such as the head-end and axle systems, the fixed charges and power or haulage would have to be taken into account.

Philadelphia Company Section, National Electric Light Association.

The regular monthly meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held on Monday evening, April 17. The meeting was one of the most enthusiastic of the season.

Three papers were presented, the first, by Geo. F. Peifer, chief engineer of Station F, being "A Historical Sketch of the Philadelphia Brush Station," which was the first electric light station operated in Philadelphia, and with which Mr. Peifer has been connected as chief engineer since its beginning, or for the past thirty years.

The many troubles of the pioneer lighting companies were outlined, and the gradual increase in size in both the electrical and steam units was described and illustrated by numerous lantern slides. One of the most interesting facts brought out was that a serious accident in either the electrical or the mechanical part of this station was unknown, and that much of the apparatus installed thirty years ago was in active use, or capable of being used, until six months ago.

The second paper was on "The Phenomena of Cyclones, Tornadoes, etc.," by Geo. S. Bliss, section director of the United States Weather Bureau. Mr. Bliss demonstrated by his talk and with the use of lantern slides the theory of wind disturbances, from enormous movements, such as trade winds, etc., to purely local disturbances, such as tornadoes. The talk was a popular one and so expressed as to be understood by everyone present. As section of Philadelphia had been recently visited by a tornado the remarks on this variety of wind disturbance were particularly interesting.

The statement that a tornado column could not exist without a peripheral velocity of between 200 and 400 miles per hour was appalling, and also that the action of the tornado reduces the atmospheric pressure from 2,000 pounds per square foot to as little as 1,000 pounds per square foot explained very graphically the enormous destructive force of such a disturbance.

C. J. Russell, of the Philadelphia Electric Company, described the course of the recent tonado in the vicinity of Tacony, which was purely local, covering a path approximately two miles long and not more than one hundred yards wide. All the trees, telegraph and electric light poles, and buildings in its path were seriously damaged. The Pennsylvania Railroad signal tower at Tacony was lifted from its foundations and carried 100 feet. The storm destroyed all the electric wires radiating from Station J so that this generating station was completely shut down.

A remarkable piece of aerial line construction was accomplished within the next six days, as some seventy sixty-five-foot poles were erected and sixty miles of wire strung, a large portion of which was No. 0 in size. Service was reintroduced to the principal consumers within twenty-four hours by the installation of about one mile of three-conductor cable buried about fifteen inches below the surface of the ground. The entire service was restored within five days, and within six days the station was operating normally.

The meeting was preceded by the usual business meeting, at which the Membership Committee announced a total membership of 449, and the Prize Award Committee announced the award of two prizes. The first was awarded to J. W. Sylvester and the second prize was awarded to Frank T. Adams.

The New York Public Library.

The Electrical and Mechanical Equipment of the New Library Building.

The new building of the New York City Public Library at Fifth Avenue and Forty-second Street contains many features of more than passing interest. Briefly stated, the electrical plant consists of a 240-volt, two-wire direct-current system, with storage battery floating on the line, supplying both lamps and motors from the same bus.

The generators are driven by single-cylinder Fitchburg engines, steam being supplied at eighty pounds pressure by Babcock & Wilcox boilers, the exhaust being utilized for heating purposes.

THE PUBLIC LIBRARY OF NEW YORK CITY.

A low-voltage system for operating call-bell circuits, time clocks, fire alarms, and other communicating devices, is also provided, current being obtained from motor-generators and storage batteries.

BOILER ROOM.

The boiler room is situated on the Fortieth Street side of the building about thirty-five feet below the level of the library grounds, and contains eight Babcock & Wilcox hand-fired boilers arranged in four batteries. Each boiler has a normal capacity of 222 horsepower, and possesses a grate area of forty-nine and three-eighths square feet, heating surface of 2,222.5 square feet and is capable of carrying an overload as high as 100 per cent of the normal rating. Connection is made through duplicate valves to the twelve-inch main steam pipe, and thence to the delivery drum. An auxiliary boiler main of eight-inch diameter is also provided in case of emergency or repair.

COAL DELIVERY AND ASH REMOVAL.

Coal is delivered to a weighing bin of six tons capacity on the boiler-room level, and by a bucket conveyor to four coal bunkers above, the final distribution to the boiler-room floor being effected by a Howe automatic weighing distributor, which, being suspended from a track parallel to the furnaces, may be moved to a position under any of the upper bunkers at will. In addition to these bunkers, each of which has a capacity of 200 tons, there are provided four fifty-ton reserve bunkers on the boiler-room floor with delivery connections direct from the street, thus making a total storage capacity of 1,000 tons. The same bucket conveyor used for coal distribution may be used for clearing the ash hoppers of each boiler either to a storage bin of five tons capacity, or to the street.

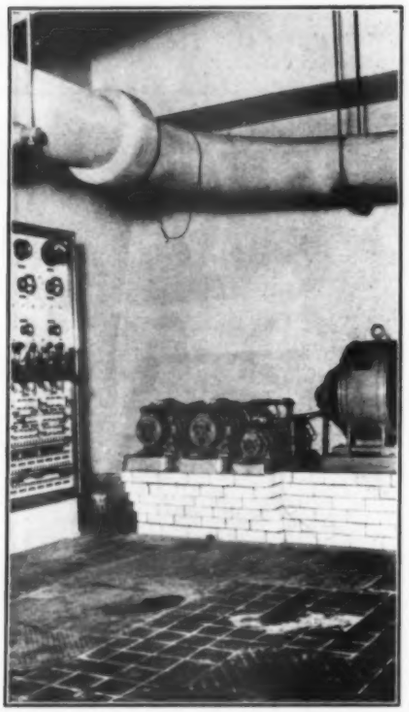
PUMP ROOM.

The pump room adjoining the boiler room contains three 7.5-inch by 4.5-inch by 10-inch duplex plunger pumps for boiler feed, two 6-inch by 4-inch by 6-inch piston pumps for draining blow-off and drip tanks, a steam-driven piston pump and an electrically-driven centrifugal pump both used for

draining the boiler-room sump. In addition, here are also located the high-pressure drip tank, blow-off tank, feed-water heater, and two Westinghouse air compressors operating in conjunction with automatic sewage ejectors, the drainage wells of the building being below sewer level.

ENGINE ROOM.

Immediately east of the boiler and pump rooms, but at a higher level, is situated the engine room containing two 500-kilowatt, twelve-pole, 250-volt, Westinghouse, two-wire direct-current generators, compound wound, each driven at 100 revolutions per minute, by a single-cylinder Fitchburg engine of thirty-inch bore and forty-eight-inch stroke. There are also two small-



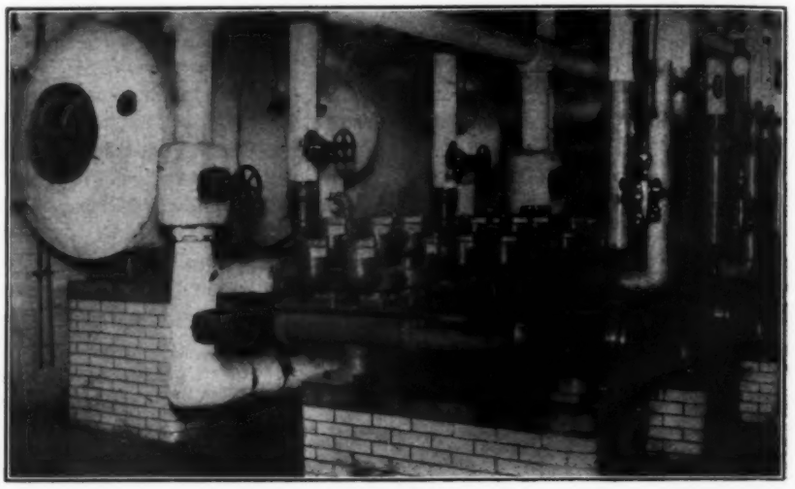
LOW-POTENTIAL MOTOR-GENERATORS.

er units, viz.: 200-kilowatt, six-pole, 250-volt, Westinghouse, two-wire direct-current generators, compound wound, each driven at 150 revolutions per minute by a single-cylinder Fitchburg engine of twenty-inch bore and thirty-inch stroke.

Each engine is equipped with a Monarch speed limit and automatic stop closing the throttle should the speed rise excessively beyond the normal. The automatic stop can also be operated from two different points on the engine-room floor by push-button control.

The lubrication of all bearings on engines and generators is effected by the Peterson pressure system, sight-feed oil cups also being provided.

A fifteen-ton hand-operated Whiting crane of thirty-one-foot span travels the entire length of the engine room,



PUMP ROOM.

and a sidewalk lift capable of conveying 3,000 pounds at fifty feet per minute permits the transfer of supplies, etc., from the street level.

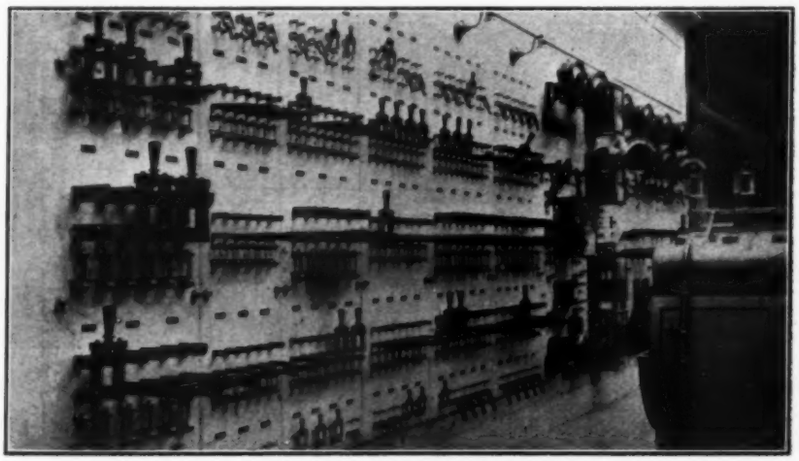
An office, glass-inclosed from the engine room, is provided for the superintendent of the building. There is a well equipped machine shop with individual motor drive for the repair of machinery and apparatus, while for cleaning purposes vacuum and compressed air systems are installed with pipe connections to all parts of the building.

SWITCHBOARD.

The switchboard, which is of two-inch white marbleized slate, contains twelve panels, six of which are for distribution. Each of the four generator panels contains double-pole circuit-breakers, main and equalizer switches, field rheostat, illuminated dial voltmeter and ammeter. On the recording instrument panel are placed Westinghouse graphic recording current and potential instruments, a Thomson recording wattmeter for the power circuit, and a similar instrument for the lighting circuit.

STORAGE BATTERY.

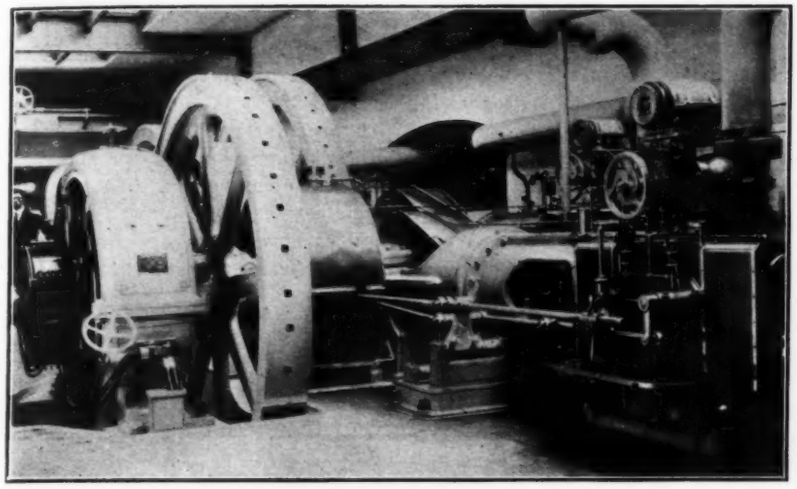
The storage battery consists of 141 Electric Storage Battery Company's cells possessing a capacity of 960 am-



THE MAIN SWITCHBOARD.

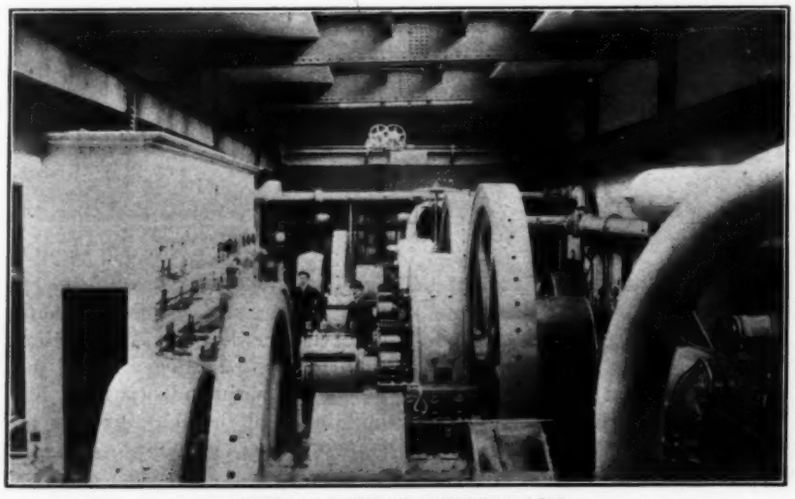
pere-hours when discharging at 120 amperes, and capable of discharging at the rate of 480 amperes for one hour. The cells are located in three compartments adjoining the engine room, properly ventilated and drained. Of the 141 cells, thirty-four are ar-

ranged to be used as end cells, being connected through a motor-driven sliding-contact switch operated from the battery panel of the main switchboard, the end-cell number being automatically indicated in full view thereon. A low-reading voltmeter is also provided



200-KILOWATT GENERATING UNIT.

which may be connected across any one of the thirty-four end cells to indicate their potential difference. It is intended that the storage battery shall eventually float on the line, and to that end a thirteen-kilowatt booster set is provided, whose starting rheostat, circuit-breakers, field rheostat,



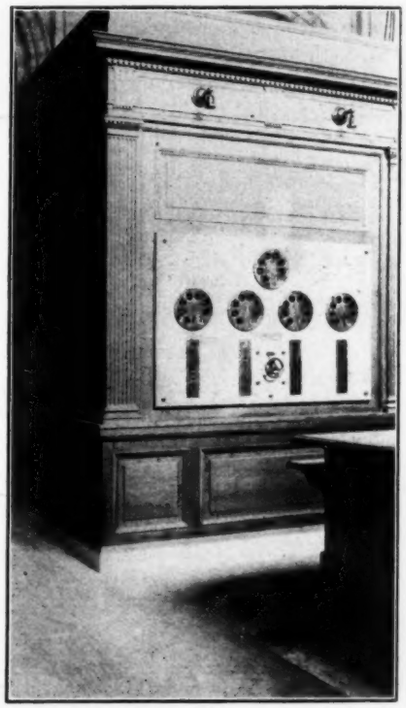
GENERAL VIEW IN ENGINE ROOM.

etc., are also located on the battery panel of the main switchboard. On the same panel are also the double-throw battery charge and discharge switch and circuit-breakers, together with illuminated-dial ammeter and voltmeter and a Westinghouse graphic recording ammeter. An additional motor-generator set of five-kilowatt capacity with separate switchboard and controlling devices is situated in the engine room for the charging of the storage batteries used on the library's electric wagons.

COMMUNICATION SYSTEM.

Outside communication with the various departments is provided for by fifteen trunk lines connected to two telephone switchboards in the public telephone room on the main floor, which also contains ten public booths.

Complete internal communication is provided among individual departments and floors by means of eleven separate systems of intercommunicating telephones, some of which allow communication between as many as twelve points. The current for the speaking circuits of these telephones is provided by twelve batteries of three Electric Storage Battery cells of eighty ampere-hour capacity located adjoining the engine room, while that for the bell circuits is obtained from two 500-watt, twenty-five-volt, motor-generators working in conjunction with a storage battery of fourteen Electric Storage Battery cells of the same capacity. For charging these cells a 250-watt, 25-40-volt motor-generator is provided, connection being effected through the switchboard. Connected to this same twenty-eight-volt circuit are the fire-alarm system, some twenty call-bells and annunciators, eighteen closing gongs operated from one push button, fifty time clocks distributed throughout the building operated from a master clock on the main floor, and other signal systems.



BOOK-LIFT INDICATOR AND CONTROL IN MAIN READING ROOM.

A pneumatic tube system operating on the "vacuum" system with duplicate ten-horsepower rotary blowers in the basement is provided with a "central station" in the center of the main reading rooms on the third floor, with connections to twelve different points in the stack and other rooms.

BOOK TRANSPORTATION.

For the delivery of books from any of the seven stack-room floors to the main reading room (which is situated immediately above them), are provided

six book lifts capable of conveying 250 pounds at 150 feet per minute. These lifts are operated by push-buttons and when operated from the reading-room floor can be brought from any level and sent to any level, whereas an operator on any of the seven stack-room floors can bring the lift to that floor and send it to the reading-room floor only. In addition, the four center lifts are arranged so that it is possible to operate them from the switchboard independent of all other control.

Five other book lifts of the same capacity are also placed in different parts of the building with complete push-button control, enabling them to be brought from any point and sent to any desired floor. With the exception of the four center lifts operated from the swithchboard, as previously mentioned, the control is so arranged that the motion of a lift cannot be changed until its destination has been reached.

A horizontal book conveyor capable of carrying a book 18 inches by 14 inches by 5 inches, weighing fifty pounds, at a speed of 150 to 250 feet per minute connects Document Room No. 212 with the sixth floor of the stack room. A conveyor of the same capacity also connects the same room with Special Reading Room No. 220, both conveyors being operated by push-buttons from either end.

There are two passenger elevators running to the third floor, and a freight elevator from the cellar to the seventh floor of the stack room.

PRINTING DEPARTMENT.

A very complete printing department and bindery is located on the main floor with five presses of different sizes, four linotype machines, and the usual accessories, all having individual motor drive and control.

VENTILATION.

A very complete system of ventilation is installed, four twenty-foot Sturtevant fans driven by twenty-horsepower C. & C. motors at 110 revolutions per minute, delivering a supply of pure air to the main reading room, catalog room, director's office, etc., the air being taken from the courtyard on the Fortieth Street side of the building, where proper filtering and heating apparatus are installed, the foul air being finally removed by nine fans driven by ten- and five-horsepower motors placed in the attics. For the ventilation of the smaller-size rooms, individual blowers of smaller capacity are provided.

ILLUMINATION.

As can be imagined special care has been taken with the illumination features of the library, first, in securing uniform illumination of the proper "tone," and second, in the design of the various fixtures to harmonize with the architectural features of the building.

At the time of writing the work of installing the various lighting fittings is not far enough advanced to permit of any adequate description of the illumination. A general idea, however, of the elaborate appearance of the work can be gained from the illustration herewith, which shows one of the eight candelabra situated in the rotunda of the main entrance on the Fifth Avenue side. In another illustration is shown the main reading room, lighted by twenty-two chandeliers, each containing ninety sixteen-candlepower lamps and capable of being connected in circuit by remote-control switches operated from the administrative inclosure in the center of the room. On the tables (shown in the illustration in an unfinished state) are to be provided individual lamps for the readers, with proper diffusers to afford uniform illumination.

In conclusion, thanks are hereby expressed to N. F. Borg, chief engineer, for his efforts in obtaining the excellent photographs, and for many courtesies shown we are indebted to the architects, Messrs. Carrere & Hastings, and various members of their staff; to the senior member of Pattison Brothers, consulting electrical engineers for the Library; N. C. Pember, of the Lord Construction Company, contractors for the electrical equipment; and to H. Fedeler, superintendent of the library building, and the able members of his staff.

ELECTROLIERS IN UNCOMPLETED MAIN READING ROOM.

CANDELABRUM IN ROTUNDA.

New York Electrical Society.

"The Electrical Equipment of the New York Public Library" was the subject of a talk by Frank A. Pattison before the New York Electrical Society at its meeting on April 28. After the address, the members of the Society visited the new library and inspected the equipment.

Ideals of Engineering Education.

At the meeting of the Electric Club, Chicago, on April 19, an address was made by William C. Bauer, professor of electrical engineering at Northwestern University on "The Ideals and Aims of Engineering at Northwestern University."

Preceding this address announcement was made of the resignation of C. A. Howe, the vice-president of the club, whose business arrangements have required that he leave Chicago for a post in Toronto, Canada. A motion expressing the regret of the club at his loss, and thanks for his past services, was unanimously carried.

Professor Bauer prefaced his remarks by exhibiting a photogravure of the handsome new engineering building which has been constructed upon the lake front at Evanston, Ill., on the campus of Northwestern University. A view of this building is shown herewith.

SWIFT HALL OF ENGINEERING, NORTH WESTERN UNIVERSITY.

The speaker anticipated any criticism that might be made of the establishment of another school of engineering in view of the large number of technical schools already existing, by stating the reasons which had actuated the university in founding this department. While it was recognized as necessary to make the university a complete institution it was not intended that it should be merely a duplicate of schools already existing, but that it should aim to realize the highest ideals of engineering education. In addition to an engineering degree it is necessary that a graduate who would become a successful engineer should have talent, training and tact. Talent is indicated by the natural interest and curiosity which the individual takes in the phenomena of nature and the applications of science. The training is supplied by the university, but the third element, tact in dealing with men and with the conditions met in practical life, is also necessary, but at present receives little or no attention in engineering schools. It is repeatedly stated by business men that the college graduate is not practical, which really means that he is not tactful.

The advantage of college education to the young engineer is that he can appreciate the reason for doing things and is able to forge more rapidly to the front than the non-graduate. If he starts out right he will be practical upon reaching the age of thirty years. He should not be judged on this point while he is too "green."

The Northwestern ideal is that the good engineer should have a liberal education and a course of five years has been laid out to this end, it being considered better to have the general and technical studies intermingled than to require a previous academic training. The same courses in science and mathematics are given to both engineering and classical students and the acquaintances thus developed with men who will later follow other professions is considered very advantageous. Professor Bauer mapped out the course which is given in electrical engineering and stated that two of the principal aims of this course were to teach the student the "why" rather than the "how" things are done, and to reduce the lag which so often exists between pure and applied science. That is, they aim to increase the power-factor of the student. During each summer vacation the student is required to spend at least six weeks in practical engineering work, and submit a report upon the same. The equipment of the laboratory is at present not very extensive, as the engineering courses were started in 1909 and at present the students are mainly freshmen and sophomores. It is not intended to compete with other institutions in the extent of the laboratory equipment, as visits to working plants will be depended upon to make the students familiar with the various types of electrical machinery.

John F. Hayford, the dean of the University's Engineering School, supplemented Professor Bauer's remarks and pointed out that the college professor like the scientific worker in the Government services does not enjoy the leisure which is sometimes attributed to his position.

E. H. Freeman, professor of electrical engineering at the Armour Institute of Technology also made a few brief remarks.

Electricity in Brazil.

The Vice-Consul at Rio de Janeiro reports in the *Daily Consular and Trade Reports* that there is a growing demand in Brazil for all kinds of electric-lighting supplies. Of an annual importation of about $3,500,000 in electrical supplies and apparatus, the United States furnishes approximately fifty per cent, Great Britain and Germany furnishing most of the remainder in about equal shares.

As yet few of the smaller cities have adopted electricity for lighting purposes, the chief demand being in the cities of Rio de Janeiro, Sao Paulo, Bahia, Para, Manaos, Pernambuco, Rio Grande do Sul, and Pelotas. Even of the above, only the first two have adopted a general system of electric lighting. A few interior cities like Bello Horizonte, Juiz de Fora, and some smaller cities have adopted electricity for public lighting.

Iowa Electrical Association.

Eleventh Annual Convention at Davenport, Iowa.

The eleventh annual convention of the Iowa Electrical Association was held in Davenport, Iowa, April 19 and 20, under the most favorable conditions. The attendance, program, exhibits of the manufacturers and entertainment features were each of equal importance in making the eleventh convention the most successful so far held by that Association. The meetings were held in a room in the Coliseum, in which building was also held the Iowa Street and Interurban Railway Association's convention and the Davenport Electric Show.

The opening session was called to order by President Thomas Crawford at 10 a. m. Wednesday. Mayor Alfred Mueller, of the City of Davenport, was introduced and in a brief but enthusiastic address welcomed the delegates to Davenport. He spoke of the relation between public service corporations and municipalities, referring particularly to the harmony between the city and operating company that exists in Davenport.

L. D. Mathes, of Dubuque, responded in his characteristic manner. He thanked the mayor for his hospitality and also referred to the Davenport public-service situation. He spoke of the local ornamental street-lighting installation and the progress of this form of lighting in other cities. In concluding his address, Mr. Mathes spoke of the great advancement that the Iowa Association has made and said that today it is considered the most progressive of any of the state associations.

President Crawford, in his address which followed, also reviewed the work of the Iowa Association and said that its development into the strongest of the state associations is evidenced by the success of the eleventh convention. Speaking of central-station work in general, President Crawford emphasized the value of a domestic heating and cooking-appliance load. In view of the improvements that have been made by the manufacturers in domestic appliances of all types these devices are practical enough in operation and economy to replace the gas and gasoline appliances. Tungsten lamps for both residence and street lighting were referred to as one of the most desirable and important business builders available to central stations. In conclusion, impending legislation was spoken of and President Crawford urged that all members take an active interest in all legislative matters pertaining to public service companies.

Reports of the various outstanding committees was the next order of business. The order in which these reports were submitted was: executive committee, facts and factors, program, membership, and committee on grounded secondaries. The report of the committee on facts and factors, presented by Austin Burt, of Waterloo, chairman, was particularly valuable as it gives detailed data relative to the operation and business of thirty-one central stations in Iowa. A table of this data is presented herewith. Chairman Burt explained that blanks had been sent to 140 central stations. Replies were received from thirty-seven, but of this number thirty-one were found suitable for use. Each station was only asked for the total connected load, the average load and the total hours of operation.

Station No.	Population of District.	Consumers per 100 Population.	Station Capacity.	Station Capacity per Capita.	Station Capacity per Employee.	Ratio of Sta.Cap. to Conn. Ld.	Average Ld.	Ratio of Av. Ld. to Sta. Capacity.	Annual Ld. Factor.	Inv. per K. W. Capacity.	Investment per Capita.	Gross Income per K. W. Cap.	Gross Income per Consumer.	Gross Income per Capita.	Gross Income per $100 Invested.	Gross Income per K. W. H. Made.	Ratio of Exp. to Gross Income.	Net Earnings per $100 Invested.	Total Time in operation.
	No.	No.	K.W.	Watts	K.W.	%	K.W.	%	%	$	$	$	$	$	$	c	%	$	Hrs.
1	700	13.4	70	100	70	200	10.0	14.3	30	100	10.00	50.00	37.20	5.00	50.00	15.9	40.0	.....	2196
2	750	13.3	75	100	37	115	45.0	60.0	80	66	6.66	40.00	30.00	4.00	60.00	21.1	50.0	.....	3110
3	800	11.3	40	50	40	.....	.....	.....	.....	187	9.40	45.10	20.10	2.26	24.10	.....	62.8	6.60	2160
4	1,200	11.1	100	83	33	.....	11.9	11.9	7.5	259	21.60	74.00	55.70	6.16	28.60	10.2	70.0	5.72	6050
5	1,300	14.9	65	50	22	.....	8.8	13.5	11.6	338	16.90	176.00	93.30	5.38	31.80	10.0	77.6	3.64	8000
6	1,300	20.2	50	38	25	33	9.8	19.6	24.3	270	14.20	133.00	25.30	5.13	36.10	17.2	83.9	2.34	3987
7	1,500	10.0	100	67	50	100	.....	.....	30	136	9.60	68.00	45.30	4.53	49.90	.....	99.0	—5.10	6500
8	1,500	10.0	60	40	12	31	11.4	19.0	19	367	14.60	125.00	50.00	5.00	34.10	7.5	66.7	7.96	8760
9	1,600	4.1	100	62	33	83	.....	.....	.....	90	5.60	72.00	107.50	4.50	81.00	.....	77.5	10.00	2600
10	1,750	16.1	150	86	75	100	15.8	10.5	19.8	100	8.60	51.50	27.60	4.42	51.60	8.2	85.7	2.23	6000
11	2,000	7.2	120	60	30	.....	27.9	28.2	56	200	12.00	60.80	50.70	3.65	30.40	3.3	91.2	—0.38	7800
12	2,000	6.0	75	37	25	112	23.9	31.9	.....	180	6.75	72.00	45.00	2.70	40.00	8.8	86.2	1.48	2555
13	2,000	9.1	55	27	18	67	20.9	54.0	60	273	7.50	129.00	39.00	3.57	47.50	7.4	64.7	12.10	3240
Av. 1911	1,415	11.9	82	62	36	94	19.4	26.3	33.8	205	11.03	84.30	48.20	4.33	43.50	10.9	73.4	4.23	4840
Av. 1909	1,600	10.0	67	42	27	94	.....	.....	36.0	236	10.00	94.00	37.00	4.06	38.00	.....	70	.....	.....
14	2,500	13.0	100	40	20	50	30.0	30.0	43.7	250	10.00	131.50	40.40	5.26	52.60	7.1	80.7	.91	6120
15	2,500	18.0	155	62	26	32	37.9	24.4	31.6	229	14.20	98.20	30.50	5.48	38.60	4.2	66.2	8.82	8700
16	2,600	8.8	250	96	50	83	27.4	10.9	23.7	120	11.55	55.60	60.40	5.35	46.40	5.8	77.3	5.87	8730
17	3,000	10.8	125	42	21	.....	.....	.....	.....	160	6.67	48.00	18.40	2.09	30.00	5.7	80.0	10.00	6500
Av. 1911	2,650	12.7	157	60	29	55	28.4	25.1	33	190	10.61	83.20	37.40	4.52	41.90	5.7	76.1	6.39	7620
Av. 1909	2,470	10.0	122	44	38	48	.....	.....	.....	221	9.40	95.00	43.00	4.04	41.00	.....	63.0	.....	.....
18	3,200	11.7	125	39	25	103	20.1	16.1	22	256	10.00	88.60	29.60	3.46	34.60	6.66	77.9	3.16	8270
19	4,000	11.9	250	63	15	43	58.0	23.2	22	294	18.40	125.30	65.90	7.83	42.50	6.16	61.4	12.18	8760
20	4,000	15.3	370	93	53	86	35.4	9.6	36.2	157	14.52	54.00	32.60	5.00	35.00	11.00	57.5	11.18	5143
21	4,500	11.5	180	40	26	90	25.0	13.9	35	352	14.43	90.40	31.30	3.62	25.10	7.43	85.5	1.12	8764
22	5,000	7.2	210	42	26	62	51.0	24.3	19	241	10.13	61.80	36.40	2.59	25.60	3.50	58.3	8.14	7250
23	7,800	11.5	300	39	50	59	63.0	21.0	26	187	6.40	111.00	37.00	4.27	66.50	6.03	55.5	23.00	8760
Av. 1911	4,580	11.5	239	53	33	74	42.1	18.0	26.7	248	12.30	88.50	38.75	4.46	38.25	6.78	67.1	9.95	7720
Av. 1909	5,670	10.0	285	51	37	50	.....	.....	.....	202	10.00	85.00	42.00	4.40	49.00	.....	56.0	.....	.....
24	10,000	10.8	833	83	114	87	120	14.3	21.6	264	22.00	73.20	50.70	6.10	27.80	5.81	51.2	10.72	8760
25	10,500	.....	2000	199	200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
26	14,000	10.1	850	61	77	43	77.0	9.1	23.5	300	18.20	60.00	36.30	3.65	20.00	7.57	59.6	6.04	8760
27	18,000	4.3	1350	75	193	111	146.0	10.8	19.3	296	22.20	39.70	73.20	2.97	13.40	4.22	59.0	4.13	8760
28	20,000	8.4	1000	50	56	39	222	22.3	26	250	12.50	87.40	51.70	4.37	31.90	4.48	50.0	13.96	8760
Av. 1911	14,500	8.4	1206	92	128	70	141	14.1	22.6	277	18.70	65.70	52.95	4.27	24.10	5.52	54.7	8.71	8760
Av. 1909	15,500	5.0	775	50	71	67	.....	.....	22	139	8.00	60.00	60.00	3.20	54.00	.....	71.0	.....	.....
29	33,000	9.5	2200	66	91	31	519	23.6	28.1	432	28.80	82.90	57.80	5.52	19.20	4.02	50.2	7.67	8742
30	48,000	3.2	1275	27	106	50	283	22.2	37	580	15.40	77.40	64.30	2.06	13.30	3.98	43.8	6.17	8760
31	86,000	5.8	5200	61	45	46	1158	22.3	29.4	612	37.10	81.40	84.70	4.92	13.35	4.17	52.9	4.95	8760
Av. 1911	55,600	6.2	2890	51	81	43	653	22.7	31.5	541	27.20	80.50	68.90	4.17	15.27	4.06	48.9	6.26	8750
Av. 1909	53,000	5.0	2110	46	262	42	.....	.....	24	195	9.00	88.00	79.00	3.50	42.00	.....	51.0	.....	.....
Gr. Av. 1911	14,920	10.6	576	64	51	72	117	22.0	30.1	252	13.85	82.10	47.60	4.36	36.80	7.75	67.5	7.82	6710
Gr. Av. 1909	9,411	9.0	401	44	63	56	.....	.....	32	220	9.60	89.50	46.00	3.93	41.60	.....	64.0	.....	.....
Gr. Av. 1911-1909	11,760	9.9	494	55	56	65	.....	.....	30.6	237	11.95	85.50	47.00	4.17	38.85	.....	65.9	.....	.....

A brief discussion of this report was entered into by Prof. A. H. Ford and Mr. Burt. Professor Ford contended that the load factor of each station should have been figured according to the rules standardized by the American Institute of Electrical Engineers.

The report of the committee on grounded secondaries was then presented by Prof. A. Shane, of the Iowa State College. This report comprises the results of tests made on various grounding devices at the Iowa State College at Ames. The report states that in August, 1909, twenty-six grounds were made within an area of about forty square feet near the college power house. The soil at the point selected is a black muck and is nearly always damp to within three or four feet of the surface. The tests for all grounds being conducted under the same conditions, the results are of value only for comparing the different grounds tested. There were thirteen different kinds of grounds, each one being duplicated so as to afford a check on the result. The source of power used is a 120-volt sixty-cycle alternating-current circuit. Readings are taken every four or five days. The resistance of each pair of grounds was measured in series and also each ground was measured in series with the college water-main system. The accompanying table is a summary of the results at Ames and also at Iowa City, parallel tests being carried on there.

SUMMARY OF RESULTS AT AMES.

	Max.	Min.	Mean.	Relative.	Relative to last year.	Ratio of Max. resistance to Min.
Iron plates in earth	12.0	6.8	9.9	1.18	1.28	1.76
Iron plates in charcoal	16.8	8.3	12.9	1.54	1.55	2.02
Copper plates in earth	10.8	7.1	8.6	1.02	1.13	1.52
Copper plates in charcoal	32.0	9.9	19.6	2.34	2.31	3.24
Aluminum plates in earth	15.1	8.6	11.3	1.34	1.39	1.75
Aluminum plates in charcoal	67.0	15.8	34.8	4.15	3.96	4.25
Garton-Daniels in earth	20.6	8.8	13.0	1.55	1.73	2.34
Garton-Daniels in charcoal	Discontinued.					
1.5-inch pipe in 6 feet earth	15.5	8.8	11.6	1.38	1.45	1.76
1.5-inch pipe in 6 feet charcoal	38.8	9.4	22.1	2.63	1.72	4.13
1.5-inch pipe in 3 feet earth	Discontinued.					
1.5-inch pipe in 10 feet earth	11.6	6.2	8.4	1.00	1.27	1.82
1.0-inch pipe in 15 feet earth	11.8	7.5	9.8	1.17	1.46	1.57
Paragon cones in earth	34.0	14.2	22.8	2.72	....	2.40
Paragon cones in charcoal	35.6	11.8	19.4	2.31	....	3.02
SUMMARY OF RESULTS AT IOWA CITY.						
Federal	540.0	45.8	175.0	8.15	....	11.8
Garton-Daniels in coke	28.9	15.6	21.5	1.00	....	1.85
Universal	119.0	58.0	88.5	4.11	....	2.05
¾-inch pipe in coke	236.0	34.4	118.4	5.5	....	6.85
¾-inch pipe in earth, 5 feet	139.0	28.5	68.2	3.17	....	4.87
Paragon	185.0	43.5	99.5	4.63	....	4.25
1.5-inch pipe in earth, 5 feet	66.0	23.1	40.8	1.9	....	2.86

The report concludes that galvanized iron pipe appears to give somewhat the best ground. As to the size of pipe, it will be seen that the 1.5-inch pipe ten feet deep gave lower resistance than the one-inch pipe fifteen feet deep.

The appointment of the nominating committee concluded the morning session.

AFTERNOON SESSION.

A paper by Ira L. Craig, of Waterloo, entitled "Waterloo Transmission Records," was the first business taken up at the afternoon session.

WATERLOO TRANSMISSION RECORDS.

This paper outlines the system of transmission records employed in Waterloo and emphasizes the importance of keeping such records. The transmission system of a central station forms part of the property of that station equally as indispensible as the generating system. The paper states that due to the fact that the electric system is above the ground and always in sight, the matter of keeping accurate records of its location and make-up has been neglected to a great extent except with the larger concerns. However, such records are of importance on account of their engineering value. All proposed extensions and additions to a system may best be planned with careful attention to the change of balance coming from such an improvement. In this connection a case of an extension in Waterloo was cited wherein the keeping of records effected a noticeable saving in time and expense. The author states that to obtain the information concerning the location of the lines necessary for the record a map of the city was made; cut into sections and mounted on cardboard. Each circuit in a section was then drawn on the maps; red ink denoting the primary lines, small crosses lightning arresters and small circles transformers. The secondary lines leading from the transformers were drawn in green, the line being solid for a three-wire secondary and dotted for a two-wire secondary. All special apparatus is written on the maps. Regarding transformers, a canvass of the system was made and the size, manufacturer's number, primary and secondary voltages of each transformer was obtained and recorded, together with the location of the instrument as regards the circuit it is on and its location on the streets of the town. The other information necessary is a list of the size and lengths of wire that make up the circuits. To get this a canvass of the system was made and the size of all wire taken with a standard gauge. In recording these records a diagram of the pole top is made in a book of field notes and each wire indicated and named, with its size specified. The notes specify where the pole is located and for how many spans or to what point the pole-top arrangements remain the same. All this data is recorded on the section maps which is in turn assembled into one map. A number of maps and record sheets were exhibited and explained by the author.

In reply to a question by Austin Burt as to the standard size of feeders in other cities, President Crawford said that it depends entirely on local conditions.

H. B. Gear, of Chicago, answering this same question, said that the practice in Chicago is to use No. 0 wire for feeder wires and No. 6 for branch lines. By standardizing No. 0 feeders and No. 6 branch lines, additional loads may always be taken care of. A number of questions relative to the method of arriving at certain of the figures exhibited were asked of Mr. Craig.

The next paper presented was entitled "Refrigerating; Advantages and Disadvantages," by G. W. DuMont, of Omaha.

REFRIGERATION.

This paper considered both central-station ice making, and refrigeration as a central-station load. Considering first the ice plant as an auxiliary to the electric business the author recounted, briefly, a few of the advantages such as increased summer revenue, establishment of a day circuit with the central station as largest consumer and the central station becoming more closely associated with a community. Mr. Du Mont spoke in favor of the motor-driven compressor in preference to the steam, contending that where no day circuit exists an ice plant with a motor-driven compressor can be installed and a day load be made profitable. The flexibility was another advantage mentioned in favor of the motor-driven outfit. Speaking of economy, installations where the total current consumption amounted to less than thirty-two kilowatt-hours per ton were cited. Mr. Du Mont spoke of the success of private refrigerating plants and the advantages to the butcher, florist, hotel, etc. He said that there is a lack of co-operation between central station companies and manufacturers of ice-making machinery which accounts for the heretofore unprogressive nature of this business.

In the discussion Mr. Du Mont said that a ton of ice could, under ordinary conditions, be made for $1.25 and that a ready market could always be found for the manufactured product. There was also brought out in the discussion answers to Mr. Du Mont's contentions that central stations should establish a rate for refrigeration business and have this rate available for all who are interested in knowing it.

L. D. Mathes spoke of the co-operation that is necessary between central stations and manufacturers to advance any industry and strongly urged a closer working between electric companies and ice-machine manufacturers.

Mr. Lee spoke briefly in favor of the steam ice plant, naming several advantages which he has found from experience. He also spoke of the important of determining the capacity of a prospective plant. In regard to the price of $1.25 per ton quoted by Mr. Du Mont, Mr. Lee said that his experi-

ence has demonstrated that the cost of producing ice depends upon the output. Brief remarks were also made by A. D. Ayer, Austin Burt, F. J. Hanlon and H. C. Blackwell.

The paper by H. B. Gear, of the Commonwealth Edison Company, Chicago, entitled "Underground Distribution in Medium Size Cities," was next presented.

UNDERGROUND DISTRIBUTION.

Mr. Gear prefaced his paper with the statement that the same principles recommended for medium size cities could be applied to portions of large cities. The paper comprehensively discusses practical methods of underground construction and methods whereby popular agitation against overhead construction may be forestalled. Three general plans for accomplishing this were considered. The first comprises the rerouting of heavy feeders to side streets and alleys; the second comprises installing a conduit system for the primaries and leaving the transformers and secondaries overhead; and the third plan comprises a complete underground installation with the transformers at street intersections. By means of a diagram representing twenty city blocks, Mr. Gear indicated the routes of overhead lines and conduit systems; how lines can be located in alleys and the locations of manholes and transformers. Power systems of 500 volts potential and series street-lighting systems require extra ducts and laterals and all underground installations should be planned for a development covering five years, Mr. Gear asserting that the increased interest and depreciation charges would be less than the cost of making additions to the system. The cost of installing a conduit system was given as twenty-five cents per duct foot, with no manholes, for a four or six-duct line. Tile duct with a three-inch covering of concrete entirely around it was recommended. This concrete protects the conduit if for any reason excavations are to be made near the line. Mr. Gear referred to the entire block of conduit, so covered, that was moved in one piece recently in Chicago. The cost of service manholes was given at from $35 to $40 each and of intersecting manholes from $175 to $200. Speaking of the costs of the three systems described, Mr. Gear said that for the twenty blocks, each representing a load of thirty kilowatts, the alley system would cost $10,000, the combination overhead and underground system would cost $24,000 per block and for the entire underground system $50,000. The investment per kilowatt on the alley system would be $16; on the combination $40; and on the all underground $83.33. Regarding the maintenance of underground systems Mr. Gear said that the introduction of disconnecting switches permitting the primary to be cut out and repairs being made has helped reduce this cost. A type especially recommended was an iron box with an inverted iron-bell cover which keeps out the water. Mr. Gear referred briefly to the methods used in Chicago particularly as regards the joint occupancy of the poles by the lighting and telephone company.

In reply to a question as to the distance between the telephone and lighting wires, Mr. Gear said a distance of five feet between them is maintained.

Austin Burt asked what method of lightning protection was employed in Chicago. Mr. Gear said that all cable poles are protected by lightning arresters as is also each fifty-kilowatt transformer. He said that about one-half of one per cent of the company's equipment is destroyed by lightning each year. The distance between lightning arresters in Chicago will average between 1,500 and 2,000 feet.

In reply to a question as to the type of arrester used, Mr. Gear said that the Garton-Daniels and multipath arresters were used with equal success. The ground connection is made through No. 6 wire to a galvanized-iron pipe, eight feet in the ground through a malleable-iron cap.

Following this discussion the paper by Prof. A. H. Ford, entitled, "Flat Rates for Small Demand Consumers," was presented.

FLAT RATES.

The author touched on the causes which led to the use of the watt-hour meter, together with the system of charging a rate high enough to cover not only the charges as determined by the meter, but also the fixed charges. The consumer cost, as considered by Professor Ford, varies with the number of consumers and their location as well as the cost of billing, collecting, office and general expenses. The meter cost includes the cost of reading meters, figuring bills, making meter repairs, etc. The third division, demand cost depends on the demand of the consumer at the time of peak load on the station. One of the difficulties of using a flat rate lies in fixing a suitable basis for charge, for if the connected load is made the basis, the number of lamps will be limited, while if a certain proportion of the lights is taken as a base, more lights will be used than were agreed upon. The only logical scheme, then, seems to be the use of a current limiting device which causes flickering when an excess of current is taken by a consumer. A number of figures were given, several curves of cost per kilowatt-hour with both meter and demand limiter were included, and a number of interesting deductions drawn. Among these were the following: The cost of service per kilowatt of maximum demand is always less for consumers supplied with demand limiters than for those with watt-hour meters; the difference being greater for small consumers than for large ones. The flat rate by proper application may be made the means of turning an unprofitable investment into a profitable one. The author urged especially the use of high-efficiency lamps.

J. P. Young, of Cedar Rapids, opened the discussion, explaining that the flat-rate system of charging was applied to small consumers in Cedar Rapids as an introduction to the meter rate. A number of small offices are also on flat rate. Current-limiting devices are used in every instance.

Austin Burt, of Waterloo, said that he was theoretically opposed to the flat rate and did not see how a central station could determine between customers where it was advisable to give a flat rate and customers where a meter rate would be more advisable.

H. B. Gear, of Chicago, said that in a consideration of the two rates the diversity factor of the consumer's business must be taken into account. In this connection he mentioned a block in Chicago containing 189 customers where the investment on the meters and transformers was greater than the investment on the station equipment but the diversity of the business is so great that the load is a profitable one.

THURSDAY MORNING SESSION.

The morning session on Thursday was opened with a paper by F. H. Golding, manager of the Rockford Electric Company, entitled, "The Electric Automobile." An abstract of this paper is presented herewith:

THE ELECTRIC AUTOMOBILE.

Mr. Golding's paper calls attention to the remarkable improvements that have been effected in electric-vehicle design and construction and in vehicle batteries during the past decade. These improvements have not only made the electric automobile serviceable and reliable in practically every city or village and on all kinds of streets, but have materially reduced the maintenance costs, so that with fair rates for current, the electric is cheaper to operate than a horse-drawn vehicle. Rockford, Ill., is a city of 45,000 that shows what a central station can do to develop the use of electrics. There are about 155 of these in use and there are 77 private charging equipments in service. An off-peak charging rate of six cents per kilowatt-hour is made for those vehicle users who agree not to charge their batteries between 4 and 9 p. m. during winter. About seventy-five per cent of the charging is done at night between 9 p. m. and morning. The annual cost of operating and maintaining an electric vehicle in Rockford is about $180. The annual revenue to the central-station company is $60 to $70 per car. The company employs a capable battery and motor man to instruct the vehicle owners on the proper care of their equipment, thus getting long life out of the batteries and general satisfaction all around. Many of the private garages are located in basements, under porches and other seemingly odd but convenient and inexpensive places.

H. C. Blackwell, of Davenport, opened the discussion. He chronicled the experience of the People's Light Company with its 3,000-pound General Vehicle truck, saying that this vehicle is used for delivering supplies for both the gas and electric departments and in addition to this service is used for transporting local freight from the railroad depots. The machine averages thirty-three miles per day and has given excellent service. The battery equipment for this car comprises four sets of cells which are used alternately. The amount of current used is about 0.6 kilowatts per mile and the cost of operation averages three cents per car mile per year. Mr. Blackwell figures that the electric vehicle saves the Company $20 per month as compared to an equal

equipment of horse-drawn vehicles. An order for three 7,000-pound trucks has recently been placed by the Company.

P. B. Sawyer speaking of the labor element said that statistics compiled in Des Moines show that a saving in labor of fifty-five per cent can be made by employing electric vehicles.

In reply to a question as to the field of the electric pleasure vehicle, Mr. Golding said that about sixty per cent of the vehicles at present in service are owned by ladies and professional men.

J. P. Young emphasized some of the points brought out by Mr. Golding. He referred particularly to the desirability of the business from the standpoint of revenue and time of load, and also called attention to the comparable data on the operation of the electric vehicle available.

Harry Glass, of Pittsburg, spoke of the excellent work the Rochester Railway & Light Company has done in advancing the electric vehicle and suggested that interested managers could obtain data from Rochester.

A paper by R. M. Parker, of Fort Dodge, entitled, Ornamental Curb Illumination was presented next.

ORNAMENTAL CURB ILLUMINATION.

Three questions which are of the utmost importance in considering ornamental curb lighting are discussed in this paper. They are (1) what shall be the style of the installation; (2) who is to pay the initial cost, and (3) who is to pay for lighting and maintenance? Discussing the first question, Mr. Parker advocated the five or three-light standard with up-turned globes. For installations in large cities, the five-light standard equipped with four sixty-watt and one 100-watt lamps was recommended while the three-light post equipped with sixty-watt lamps was recommended for smaller cities. As an argument for the up-turned globe, Mr. Parker said that they are less liable to damage from vehicles, they are automatically cleaned by the rain and present an appearance of being bunched. One disadvantage mentioned was that ice is liable to form or the globes in winter. Globes of twelve-inch size for outer positions and sixteen-inch for center position were recommended. Poles should be set in solid concrete and all wiring should be lead-covered cable. Mr. Parker said that the average ornamental standard varies in cost from $30 to $60 but that $55 for the post, complete, is an average price. Considering the second question, Mr. Parker said that the initial cost should be paid by commercial clubs, merchants, property owners, etc. He thought that $1.75 per foot would cover the initial expenses of an ornamental street-lighting installation. In regard to the third question—who is to pay for the lighting and maintenance—Mr. Parker said that the city should stand this expense and also should pass a special ordinance insuring a uniform installation. As an example of the feasibility of this, Mr. Parker read a number of city ordinances having to do with ornamental installations, also with the regulating of electric signs where street-lighting installations already exist. In conclusion Mr. Parker described the installation in Fort Dodge where the cost of the standards averaged $71 each and from $100 to $125 fully equipped and set. The posts are of the five-light type and the renewals per year never exceed four 100-watt and eight sixty-watt lamps. The total maintenance cost is $23 per post per year.

A. L. Dodd, of Charles City, opened the discussion. He described briefly the installation in Charles City and said that the Company has had discouraging experience with a bridge installation, the breakage being very high.

Prof. A. H. Ford said that ornamental street lighting was a fashion. He said that people are used to glare and would not be satisfied with a subdued light. He said that opal globes give the lamp filaments an objectionable red appearance and he recommended the use of Alba glass globes.

Harry Glass referred to the installation in Minneapolis and described the

H. C. BLACKWELL,
President-elect Iowa Electrical Association.

method employed there for obtaining subscribers to the plan. He also spoke of the excellent appearance of the streets at night, secured by placing the corner posts at each corner eight feet back from the building line.

President Crawford briefly described the installation in Clinton where ninety posts are installed the maintenance cost of each per year being $25.

This discussion was followed by the paper by Harry G. Glass, of Pittsburg, entitled, "Methods of Securing and Properly Installing Power Loads."

This paper was illustrated by a large number of lantern slides of industrial power applications such as are commonly met with in Iowa. The advantages of such loads were pointed out and a number of arguments for the power solicitor pointed out.

AFTERNOON SESSION.

At the afternoon session J. D. A. Cross, of Chicago, presented his paper on "Industrial Heating Loads."

INDUSTRIAL HEATING LOADS.

This paper points out in a striking manner the great advances that have been made in the manufacture of industrial heating appliances and cites the advantages of an industrial heating load to the central station. Commercial cooking was first considered. Toasters, broilers, electric ranges, and bake ovens were described and installations of these appliances cited. Of particular interest is the installation of broilers in the Stanley Hotel, Colorado, where excellent results have been obtained. In the bake oven installed in this hotel fifteen one-pound loaves of bread are baked with a current consumption of one kilowatt-hour. For laundries, the electric flat irons, electric rolls, water heaters, etc., were mentioned as being desirable and the performnace of each device under actual conditions described. In the printing trade glue pots, glue cookers, embossing machines, matrix dryers find a field, and in many of the miscellaneous industries such as textile mills, paper-box factories, tailor shops, breweries, etc., many electric heating devices can be economically employed.

J. P. Young, of Cedar Falls, recounted his experience with heating appliances. He found the disk stove the most popular device in that line.

President Crawford asked Mr. Cross if any new developments could be looked for in electric irons. Mr. Cross said that an automatic handle which regulated the current was the only new development he knew of.

H. C. Blackwell briefly described the campaign carried on in Davenport. Fifteen per cent of all residence customers have flat irons but the percolator and chafing dish business has not been so successful, although every means to market them was tried. Regarding repairs of flat iron Mr. Blackwell explained that a nominal charge was made for all repairs, although no extra labor is required.

P. B. Sawyer said that fifty per cent of the residence customers of Des Moines have irons. All irons are repaired free.

J. P. Young explained the method of increasing the flat-iron business in the towns surrounding Cedar Rapids. The company's office is very close to the express office so that irons were sent by messenger to the express company and then sent to customers in the surrounding towns by express. Letters explaining the thirty-day plan were sent with each iron. Mr. Young said that sixty-six per cent of the residence customers had irons.

Mr. Cross concluded the discussion by describing the campaign recently carried on in Milwaukee where over 1,000 irons were sent out by uniformed messengers.

A very brief discussion of the subject of public policy was then opened by

George Carson, of Iowa City. Mr. Carson said that one of the most essential requirements imposed on central stations is that of good service. A fair and equitable system of rates is also necessary to maintain harmonious relations with the public. Mr. Carson spoke of the evils of discriminating between customers and said that lowering rates unsolicited, when warranted, is a good policy. The advantages of advertising were explained, the importance of insisting on courteous employes emphasized. Mr. Carson said that central stations should take an active interest in public matters and show that it is interested in the welfare of the City. In conclusion the importance of maintaining cordial relations with the customers was pointed out and the importance of meter testing, in this connection, referred to.

The afternoon was devoted to an executive session at which the reports of the treasurer, finance committee, and nominating committee were heard. The following officers were declared elected: President, H. C. Blackwell, Davenport; vice-president, P. B. Sawyer, Des Moines; treasurer, W. A. Mall, Belle Plaine; and secretary, A. W. Zahm, Charles City. The new executive committee is composed of L. D. Mathes, A. L. Dodd and J. P. Jones. Des Moines was selected as the meeting place for the next annual convention.

ENTERTAINMENT.

The entertainment features of the convention were carried out with a high degree of success and the committees having this in charge are deserving of much credit.

On Wednesday evening the manufacturers and supply men tendered a complimentary smoker to the members of the association at the Davenport Hotel. There was a special musical program and brief remarks were made by several present.

On Thursday evening the Tri-City Railway Company tendered a theater party at the American Theater. Immediately following this the Sons of Jove held a rejuvenation and joviation at the Kimball Hotel. A class of forty-two was initiated and the affair pronounced an overwhelming success by those present.

An account of the exhibits of the manufacturers, held in conjunction with this convention, will be found on other pages of this issue.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION.

EIGHTH ANNUAL CONVENTION AT DAVENPORT.

The eighth annual convention of the Iowa Street and Interurban Railway Association was held in Davenport, Ia., April 21, 22 and 23. Headquarters were established in the Coliseum building. The first meeting was called to order by President L. D. Mathes, who introduced Mayor Alfred Mueller of Davenport. The mayor's cordial address of welcome was responded to by C. D. Cass, of Waterloo.

The address of President Mathes was then taken up. Reviewing the work in electric railway practice during the past year, Mr. Mathes said that it has become so refined that the future will not develop any marked innovations, at least as far as can be foreseen at present. According to the speaker, a matter of great importance is that involving the standardization of operating rules for city and interurban lines. In this connection block signal systems as applied to interurban lines were referred to. The pre-payment car was mentioned as one of the most important developments of recent years, so far as city service is concerned. Mr. Mathes spoke of the present financial condition existing throughout the country, and urged that operating expenses be lessened as much as possible. In this connection reference was made to the committee appointed by the Boston Elevated Railroad to make a study of operating expenses, with a view to reducing them. Referring to local conditions in Iowa, Mr. Mathes said that the most important development of the year has been a demonstration by the legislature of the inclination of the people to give the corporate interests more favorable consideration. In concluding, Mr. Mathes urged that members give consideration to impending bills before the legislature, particularly the Public Service Commission bill.

Following this address, the report of the secretary and treasurer was read, also a progress report was submitted by the committee on operating rules.

A paper by C. W. Rhoades, of St. Louis, Mo., entitled, "The Use of Wood Preservatives—Is the Expense Justified by the Results Obtained?" was then presented. This paper presents statistics showing the large amount of timber that rots each year. The cause for this rot is explained, and the chemical effect of wood preservatives described. In advocating the treatment of railroad ties from a financial standpoint, Mr. Rhoades presents figures showing that the cost of a treated tie lasting ten years is 8.2 cents per year as compared with 8.0 cents per year for an untreated tie having a life of five years. Figured on this basis, Mr. Rhoades shows that $5.60 or $6.00 per year per mile of track is the price paid to avoid disturbing the embedment of all the ties in ten years.

At the afternoon session the first paper presented was that by Jacob Gerke, of Davenport, entitled, "Things Worth While in Shop Practice." This paper explains the construction and operation of a number of devices used in the shops at Davenport which have resulted in noticeable savings in both labor and material. The devices or tools described included a field tester, armature slotter, air drill, ventilating fan of special construction and a welding outfit.

The next paper presented was prepared by J. C. Young, of Cedar Rapids, and was entitled, "Development of the Auxiliary Load for Railway Power Plants."

DEVELOPMENT OF AUXILIARY LOAD.

The possibilities for revenue from the distribution system of an electric railway can be divided in two classes. That from the alternating-current lines and that taken direct from the 500-volt trolley. The first class is the more preferable for many reasons. First, because of the ability to utilize alternating-current motor; second, because the losses in distributing are lessened by the loss in transforming from alternating-current to direct-current. This latter item varies from nine per cent on rotary converters to fourteen per cent on motor-generator sets. It is offset to some extent by the increased investment to purchase the special transformer to reduce the potential of the high-voltage transmissions. It is possible at or near substations using motor generators to use standard transformers for this work.

Taking on direct-current business has its operating difficulties. First, by reason of the increased loss in delivery of the current, and second, because of the difficulties so prevalent in the direct-current motor, running on a grounded circuit. The opportunities are as follows: Local street railway line at both terminals; private lighting at all intermediate stations; street lighting at the largest of these stations; service for county and state institutions; power for stone crusher at quarries; power for sand pumps at river crossings; power for farmers at or near the right of way, at any point on the line; power for country elevators and sawmills and power for pumping city water. Railways are justified in getting a fairly good rate for power and light for this service. Those who have combination lighting and street railway plants can safely base their rates on an

increase of at least ten per cent to fifteen per cent over the rates charged in the cities. Those who are not acquainted with lighting rates, should post themselves on what the local company is charging and figure accordingly. The fraternal ties between the two classes of business should lead the railway man to appreciate the difficulties that the electric light man might encounter if it was reported by the man in the country that they were enjoying a much lower rate than that utilized by the city company. The lighting rate today is based on three main items. First, a consumers' charge, which does not vary with consumption. Second, an interest and depreciation charge based on the maximum demand, and third, a charge based on the switchboard cost. The railroad man might not consider in quoting a rate, the first two items, and base his price on the manufacturing costs only, and if he does, he is surely giving a discriminating rate. If this is the case, he not only is tearing down the system that is absolutely essential to the success of the central station, but is doing his own company an injustice by not getting all the revenue that the circumstances will warrant. The exclusive railway plant of today has considerable difficulty in generating current at a lower cost than the city lighting plant. Intensive business methods are rapidly proving to the majority of power users the cheapness and the convenience of power from the central station. In consequence the load curve is much more conducive to low cost of power than that of the average railway station without storage-battery installation An increase rate for service in the country is justified, due to the increased cost to deliver the current. In the average distribution system for railway work, the current is generated at a standard voltage stepped up to high tension, transmitted and stepped down to a proper voltage for motor generators or rotaries, transformed to direct current and distributed to the car by trolley. Each step results in a loss. For lighting and power service, the current is generated at the voltage at which it is distributed to the one set of transformers required to get the low voltage needed by the standard lamps and motors. That aggregate loss will average 12 to 13 per cent in well designed plants but in the railway proposition an additional loss must be considered which will amount to a total of twenty-five to thirty per cent depending on the length of line and other factors. This does not in anyway handicap the company in securing contracts as it is not difficult to create a demand. It exists at all times and particularly at this time when the farmer seems to be the most prosperous class of men. Each and every one of you have been, no doubt, called upon to submit a proposition to a customer of this character.

The author then presented figures showing the investment and possible revenues from the various classes of business mentioned.

At the session on Friday morning a paper by Frank S. Cummings, entitled, "Methods of Handling Snow Storms," was presented by the author. This paper describes the equipment necessary to cope with a snow storm on the average railway system. A comparison is made of the various appliances on the market and the best methods of precedure are explained

This paper was followed by the paper by J. C. C. Holden, of Chicago, entitled, "Steel or Steel-tired Wheels vs. Cast Iron." This paper gives a historical review of the steel freight-car wheels, compares it with the cast-iron wheel and enumerates the advantages of the former. The process of manufacture was described in detail and general statistics and other data presented by the author.

On Friday afternoon the delegates visited the car shops at Davenport and witnessed a demonstration of the Thermit welder. A special car transported the delegates from the Davenport Hotel to the shops.

An executive session was held on Saturday morning at which unfinished business was taken up. The report of the nominating committee was also presented and the following officers elected: President, J. F. Porter, Davenport; secretary-treasurer, George W. Macartney, Des Moines.

The same entertainment features provided for the Iowa Electrical Association, as mentioned elsewhere in this issue, were also participated in by the Railway delegates.

Ohio Public Utility Companies Merge.

The merger of nine street railway, electric light and heat companies was completed at a meeting held recently at East Liverpool, O., and the officers chosen issued a statement in which it is said that the headquarters of the holding concern, the Tri-State Railway & Electric Company, would be located in that city. This company was recently incorporated under the laws of Ohio and is financed by J. G. White & Company, of New York, and the Drexels, of Philadelphia. The new concern will have absolute control of all the street railways and electrical concerns in this territory and its holdings, which are secured by a lease for 999 years, represent an investment of nearly $10,000,000.

Included in the merger are the Beaver County Light Company, Midland Electric Light & Power Company, the Ohio River Passenger Railway Company, East Liverpool, the East Liverpool Traction & Light Company, Steubenville & East Liverpool Railways & Light Company, Steubenville & Wellsburg Traction Company, Tri-State Traction Company, Steubenville, Wellsburg & Wierton Railway Company, and the Wellsburg Electric Light, Heat & Power Company, Wellsburg, W. Va.

AMERICAN PHYSICAL SOCIETY.

SPRING MEETING AT WASHINGTON.

The meeting of the American Physical Society at Washington, D. C., on April 21 and 22, was characterized by an unusual number of papers of electrical interest, contributed largely by the staff of the electrical division of the Bureau of Standards, as follows:

"The Capacity and Phase Difference of Paraffin Paper Condensers as Functions of Temperature and Frequency." F. W. Grover.

"Resistance Coils for Alternating-Current Work." H. L. Curtis and F. W. Grover.

"The Radiant Efficiency of Arc Lamps." H. P. Gage.

"A New Determination of the Selective Radiation from Tantalum." Edward P. Hyde

"The Use of the Silicon Detector with Short Electric Waves." Ernest Merritt.

"A Method for Eliminating the Effect of All Connecting Resistances in the Thomson Bridge." F. Wenner.

"The Construction of Primary Mercurial Resistance Standards." Wolff, Shoemaker, and Briggs.

"A Tubular Electrodynamometer for Very Heavy Currents." P. G. Agnew.

"The Deflection Potentiometer Considered as a Generalized Null Instrument." H. B. Brooks.

"The Bureau of Standards' Current Balances." E. B. Rosa, N. E. Dorsey, and J. M. Miller.

"A Heterochromatic Photometer." H. P. Gage.

"Ultra-Violet Light from the Arc." H. P. Gage.

"The Measurement of Inductances with Very Small Time-Constant." F. W. Grover.

"The Thermodynamics of the Concentration Cell." H. S. Carhart.

Abstracts of these papers are given below.

The session on Friday was held at the Cosmos Club, and the two sessions on Saturday at the Bureau of Standards. On Friday evening an informal dinner was held, and on Saturday lunch was served at the laboratory of the Bureau of Standards. At Friday's session, the question of establishing a journal by the Society came up, and it was decided that it would be desirable for the Society to take over the *Physical Re-*

view, if arrangements can be made with the publishers of that journal. President W. F. Magie occupied the chair at Friday's session, and on Saturday Vice-president B. O. Peirce and E. B. Rosa presided at the morning and afternoon sessions respectively.

CAPACITY OF PARAFFINE-PAPER CONDENSERS AS FUNCTION OF TEMPERATURE AND FREQUENCY.

In an ideal condenser the charge is at every instant proportional to the applied difference of potential between its plates, and the capacity is consequently independent of the length of charge or discharge. With alternating current, the current through the condenser is ninety degrees in phase ahead of the impressed electromotive force, and the capacity is independent of the frequency. These conditions presuppose, not only a perfect dielectric, but also a negligible resistance in the leads and plates of the condenser. Actually, condensers show anomalies which are usually included under the name of absorption effects, and may be summarized as follows: (1) with a steady applied voltage the capacity depends on the length of charge, length of discharge, the interval between charge and discharge, or between discharge and recharge, that is, it depends on the previous history of the condenser. After being discharged, the condenser, if allowed to stand insulated, will yield residual charges. (2) With alternating current the phase-difference between the current and the impressed electromotive force falls short of ninety degrees by an angle, usually small, which may be designated briefly as the phase-difference. Both capacity and phase-difference are functions of the frequency. All these effects vary in magnitude with the temperature, so that the capacity changes to a greater extent with the temperature than can be explained by changes in its dimensions. A number of theories to account for the phenomena of absorption have been proposed, but most of the existing experimental work has been done with direct current, under conditions which make it difficult to compare the results with theory. The present work was done on condensers having a dielectric of paraffined paper, in which the various effects of absorption are larger and more easily measured than in mica condensers, and to obtain definiteness in the conditions of experiment, alternating current was used. The capacity and phase-difference were measured simultaneously with thirteen commercial paraffined-paper condensers for frequencies ranging from 33 to 1,000 cycles per second, and for temperatures ranging between 10 and 35 degrees. From these the following conclusions may be drawn: (1) The changes of capacity with the frequency and temperature are in every case considerably larger than those observed with mica condensers, and are in some cases from ten to fifty per cent of the value observed at the lowest temperatures and highest frequencies. (2) The phase-differences observed range from about 6 minutes to the enormous value of 22 degrees. The phase-difference of a good mica condenser may be as low as 15 seconds and usually lies under 3 minutes. (3) The temperature-coefficient of the capacity is usually negative with condensers having a small phase-difference, and tends to become more and more positive as the phase-difference is greater. In the best of the condensers the coefficient is negative and nearly linear, with a tendency to become rapidly numerically larger as the temperature is raised above thirty degrees. In the case of the condensers having large phase-differences (one degree or more) the temperature-coefficient is positive and becomes very rapidly larger as the temperature is increased and the frequency is decreased. (4) With increasing frequency, the capacity falls. (5) In the majority of cases the phase-difference increases with rising temperature. (6) The phase-difference decreases with increasing frequency except in those cases where the Fr loss in the connections and plates is considerable, when the phase-difference may actually increase with the frequency. This effect is particularly noticeable in telephone condensers made by rolling up together sheets of tin foil and paper. (7) The use of paper condensers as reference standards in work with direct current is not allowable, and should be permitted in alternating-current work only after a study of the behavior of the condenser under different conditions of temperature and frequency has shown that the performance of the condenser meets the requirements laid down by the work in question.

RESISTANCE COILS FOR ALTERNATING CURRENTS.

The measurement of alternating currents frequently requires the use of resistance coils having small reactances. A plain bifilar winding has usually been relied upon in the case of coils whose resistance lay between 1 and 1,000 ohms. Of such coils those below fifty ohms have a positive reactance, while those above 100 ohms have a negative reactance. The authors have made experiments in the design of coils to make these effects as small as possible. The aim has been to reduce the time-constant to not more than 4/100,000,000 and simultaneously to keep the dimensions of the coil such that when immersed in oil an expenditure of one watt will not raise its temperature more than one or two degrees. Coils of five different values have been experimented upon, 1, 10, 100, 1,000 and 5,000 ohms. A one-ohm resistance which meets the above requirements may be made from a strip of manganin having a width of three millimeters and a thickness of 0.1 millimeter. This is folded upon itself, the two parts being separated by a thin sheet of mica or silk. A ten-ohm coil may be made either similarly of strip manganin using a width of one millimeter and a thickness of 0.1 millimeter or of three thirty-ohm coils in parallel, the latter being made of the same wire as is used in the 100-ohm coil. The 100-ohm coil may be made of double-silk-insulated manganin wire, having a diameter of 0.24 millimeter. It is wound bifilar in a single layer on a diameter of 2.5 centimeters. The inductance and capacity effects are then very nearly balanced. The 1,000-ohm coil is made of wire having a diameter of 0.1 millimeter and is wound in five sections, each of 200 ohms. Each of these sections is a single-layer bifilar winding. The 5,000-ohm coil is wound unifilar using wire whose diameter is 0.05 millimeter. It is a single layer, two turns being wound, then the direction reversed and ten turns wound, etc. It is important that a coil made of several sections in series shall be wound upon a spool of non-conducting material. For this purpose porcelain is quite satisfactory. The coils should be shellaced and baked in the usual manner. In making coils it is not found that every coil of the same resistance, made according to the same specifications, has the same effective inductance when completed. However, the variation should not be large. The following table gives the worst values which were found when the above specifications were used.

Resistance in ohms.	Inductance in microhenrys.
1	+0.04
10	+0.3
100	—1.6
1000	—16.
5000	+220.

THE RADIANT EFFICIENCY OF ARC LAMPS.

The object of the investigation is to determine the radiant efficiency of arc lamps and the mechanical equivalent of light. The definition here used of radiant efficiency is the ratio of the energy of the visible part of the spectrum to the total energy radiated, or L/R, where

R=total energy radiated

W=energy passing through eight-centimeter layer of water.

L=energy of visible part of spectrum.

The ratio L/R or W/R was obtained by a slight modification of the method of Angström. After dispersing the spectrum of a light source the infra-red was removed by an opaque screen. The light was then reassembled by a mirror to a white spot. The energy of this white light was compared by means of a radiomicrometer with white light of equal intensity and like color from the same source which had not been robbed of its infra-red. In some cases owing to the small value of L compared with R, L was compared with the intermediate quantity W. The reasons for choosing the value of L as the energy of the spectrum included between the limits 0.4μ and 0.68μ are the small photometric effect of all energy of greater wave-length than 0.68μ, and the greater certainty of setting the cut-off screen at this than at greater wave-lengths. The most important results follow:

Source.	Efficiency. $\frac{L}{R}$ in Per Cent.	Light Equivalent of Energy. Candles Per Watt.
Positive crater, right-angle-carbon arc	8 to 12	30
Right-angle lamp, alternating current	6.5 to 8.5	21
Yellow-flame arc	15.4	39
Yellow-flame, arc stream	39	..
Brilliant white	14.6	21
Hefner, recalculated from Angström, for limit 0.68μ.	0.363	21.3
Nernst lamp viewed through copper sulphate solution.	100	39.5

The greatest efficiency of 39 per cent was found in the case of the arc stream between yellow-flame electrodes, tips shaded. The light equivalent of energy was found to be as high as 30 candles per watt with white light and almost 40 candles per watt with light distributed more in the visually sensitive part of the spectrum.

A NEW DETERMINATION OF THE SELECTIVE RADIATION FROM TANTALUM.

It has been shown heretofore that, if two incandescent bodies are at a color match and have different luminous efficiencies, one of the bodies radiates selectively with respect to the other. The existence of a color match is a consequence of there being approximately the same energy distribution in the visible spectra. A difference in the luminous efficiencies indicates that for the entire spectrum there exists a difference in the distribution. If the two bodies are not selective in their radiation with respect to one another, it was shown that at a color match they must have the same luminous efficiency. A color match may be determined with considerable accuracy with the aid of a photometer. The luminous efficiencies, in case the substances are mounted as incandescent lamp filaments, may be determined by standard methods. Untreated carbon is very closely non-selective. Former results did not include corrections due to losses in efficiency resulting from the cooling effects of the supports for the filaments, to energy dissipated in the base and the leading-in and connecting wires and to the absorption of the radiated luminous energy by the glass bulb and the deposits thereon. In some recent work these losses have been investigated. It seemed worth while to redetermine the relative selectivity of tantalum and carbon, taking into account the losses just mentioned. Two special lamps, one with an untreated carbon filament, the other

TABLE I.

Approximate Black-body Temperature Centigrade.	Measured Luminous Efficiencies in Lumens per Watt. Carbon.	Tantalum.	Corrected Luminous Efficiencies in Lumens per Watt. Carbon.	Tantalum.	Ratio of the Luminous Efficiency of Tantalum to that of Carbon. Present Results.	Previous Results.
1420	0.37	0.48	0.41	0.51	1.2	1.3
1610	1.4	1.7	1.5	1.8	1.1	1.15
1780	3.1	3.5	3.5	3.7	1.0	1.1

with a tantalum filament, were used, in which these losses could be carefully measured. The results are included in Table I.

The corrections for the losses mentioned above have changed but little the previous values for the ratio of the luminous efficiency of tantalum to that of untreated carbon, obtained by using ordinary lamps.

THE SILICON DETECTOR WITH SHORT ELECTRIC WAVES.

For the purpose of detecting short electric waves of five or six inches the author found that the silicon detector gave the best satisfaction of any detector used. The silicon was imbedded in solder and was in contact with a steel point connected to a d'Arsonval galvanometer. In order to concentrate the waves the receiver was placed at the focus of a parabolic mirror. In attempting to explain the phenomena of the contact rectifiers the theory was advanced that a free electrical charge of positive or negative electrons, according to the direction of the current, was developed at the surface of contact between the two substances. This would produce a difference in conductivity in the two directions, owing to the different carrying capacity of positive and negative electrons.

In the discussion A. G. Webster remarked on the novelty of the statement that a free charge existed within a conductor.

CONNECTING RESISTANCES IN THE THOMSON BRIDGE.

The increased demand for accurate measurements of power has necessitated the construction of low-resistance standards capable of carrying large currents. Such standards must have a resistance of definite value easily determined. Where the standards are to be used in alternating-current measurements it is also necessary that the inductance be small or known. The necessary conditions for a resistance and inductance of definite value are pointed out. An important factor in determining the value of the inductance is the mutual inductance between the potential circuit and the conductor of the heavy current. For the comparison of such resistances the Thomson bridge method is very satisfactory, but the equation for the Thomson bridge is derived on the supposition of linear conductors, while it is being applied in cases where the mean diameter of the conductor is equal to its length. While the equation is exact only in the case of linear conductors, the error introduced by using it is generally very small. In using the method it has been found that the work of making the measurements is considerably reduced if certain adjustments (the details of which can not be given in a brief abstract) are made. These adjustments eliminate the effects of all connecting resistances, in which case the equation reduces to that of the simple bridge. Where these adjustments are made correct relations between the resistances are obtained even in those cases in which the Thomson bridge equation is not valid.

MERCURIAL RESISTANCE STANDARDS.

The paper described the construction and measurement of four mercurial standards in accordance with the specifications adopted by the London International Electrical Conference. The tubes were of Jena glass and remarkably uniform, the caliber factor in every case being less than 0.01 per cent. The cleaning, measurement of length, calibrating, exhausting, filling and temperature control were made with extreme care. The electrical measurements were made by the Kelvin-double-bridge method, the primary standards and five sealed manganin standards being substituted in turn in the same bridge arm. The apparatus was immersed in an ice bath so that a constant temperature of zero degrees centrigrade was maintained. Six fillings of each each tube were made. The calculated value of the tubes minus the value in terms of the international ohm as agreed to by the International Scientific Committee in 1910 averaged twenty-five parts in one million, the probable error of measurement being about one parts per million. Expressed in terms of the ohm previously in use at the Bureau of Standards the difference would be thirty-two parts per million. The final result is subject to small corrections still to be determined.

ELECTRODYNAMOMETER FOR VERY HEAVY CURRENTS.

To obtain the same current distribution for both alternating and direct current, it is usual to strand the windings of the field coils of electrodynamometers. For very heavy currents, this becomes a matter of extreme difficulty. An entirely different method of obtaining the same end is employed in the present instrument. The field at an outside point due to a straight cylindrical or tubular conductor is independent of any skin effect if we have axial symmetry. The field "coil" consists merely of two concentric heavy copper tubes, thus giving a circular field between the tubes. There are two moving coils statically placed between the tubes, one on either side of the inner tube, and suspended by a phosphor bronze strip. The common axis of the tubes is placed in a horizontal position in order to allow the vertical suspension. While the distribution is not the same on alternating as on direct current, the magnetic field in the space between the tubes and hence the torque is the same. For cooling it is arranged so that water may be passed through the inner tube. The instrument was designed to carry 5,000 amperes, and it will carry 1,000 amperes continuously without water cooling. Magnetic impurities on the moving system are exceedingly troublesome, the requirements being even more exacting than in the moving-coil galvanometer.

THE DEFLECTION POTENTIOMETER CONSIDERED AS A GENERALIZED NULL INSTRUMENT.

The potentiometer has until a few years ago been regarded only as a null instrument. The deflection potentiometer for voltage measurements, described in the *Bulletin* of the Bureau of Standards about five years ago, showed the possibility of making precision voltage measurements with a potentiometer in which an appreciable part of the result is given by the reading of the galvanometer. More recently the question of measuring current in the same manner has been investigated. This brought up new problems, which have been solved, and the theory of the deflection potentiometer has been extended and at the same time simplified, so that all measurements within the range of a given potentiometer may be made with any current flowing in the galvanometer which the latter can measure. In addition to the two early models of deflection potentiometer described in the *Bulletin*, which were suited for voltage measurements only, two other types measuring either current or voltage have been in use for the past year by the Bureau and several laboratories in other cities. These will be described in a future issue of the *Bulletin*.

BUREAU OF STANDARDS CURRENT BALANCES.

The current balances of the Bureau of Standards are of the Rayleigh type, each consisting of a pair of fixed coils of equal radii and of square cross-section, and a moving coil of square cross-section but of a smaller radius, suspended midway between the fixed coils and coaxial with them. There is provision for water-cooling the fixed coils, and interchanging them. All coils are wound of enamel-insulated wire upon brass forms, are well insulated and sealed from atmospheric humidity. Three pairs of fixed coils have been used, one 40 and two 50 centimeters in diameter.

Four moving coils, two twenty centimeters and two twenty-five centimeters in diameter, with different numbers of turns, have been used. All portions of the balance have been tested by a very sensitive astatic magnetometer, and, excepting one discarded moving coil, found to be sufficiently non-magnetic. All weighings having been made with the coils in the positions for maximum force, the only direct measurements of length needed are those of the sectional dimensions of the coils, the main term in the expression for the force being completely determined by the *ratio* of the radii of the coils. This ratio was determined by a special measurement. In assembling the balance, the correct position of the moving coil was determined electrically, and experimental methods were devised for determining the lack of coaxiality and the error in the spacing of the fixed coils, and for determining the effect, if any, of any fixed magnetic bodies that might be near the balance. The final weighings show that the electromotive force of the Weston normal reference cells of the Bureau of Standards is 1.01823 volts, in terms of the absolute ohm. The value of these cells is 1.01830 international volts (in terms of the international ohm and the silver voltameter), showing an apparent difference between the absolute volt and the international volt of 0.00007 volt. However, there is perhaps a greater difference than this between the absolute ohm and the international ohm; hence until the absolute ohm is better determined it is uncertain whether the international volt or the absolute volt is the larger. The following values (at twenty degrees centigrade), have been found by other observers during the last four years:

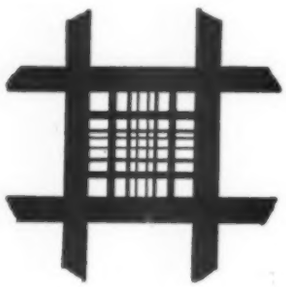
1907	National Physical Laboratory	1.01818
1908	Laboratoire Central d'Electricité	1.01870
	Laboratoire Central d'Electricité	1.01841
	Guillet	1.01819
	Guillet	1.01825
1910	Haga	1.01825
1911	Bureau of Standards	1.01823
	Mean, omitting Lab. Central d'Electr	1.01822

These results seem to indicate that the electromotive force of the Weston normal cell in terms of the international ohm and the absolute ampere is 1.01822 volts to within a few parts in 100,000.

A HETEROCHROMATIC PHOTOMETER.

A photometer constructed on the same principle as the Lummer-Brodhun photometer except that in place of the usual cubical prism there was substituted a piece of ordinary mirror, part of the silver being scratched off with a sharp knife. It was found that if instead of removing large areas of the silver, small scratches were made, these scratches could be made to disappear with such differently colored

lights that with large areas a sharp match never could be made. With this apparatus it was possible to make fairly sharp settings with such differently colored lights as acetylene, the right-angle arc, daylight, the yellow-flame arc and the Hefner lamp. When it comes to comparing red light with green light, however, the results are not at all satisfactory unless very low intensi-



ties are used. The form of pattern adopted was as shown in the figure, the black representing the silver removed.

ULTRA-VIOLET LIGHT FROM THE ARC.

In experimenting with different substances in the arc it was found that uranium gave a very nearly continuous spectrum from the visible to the ultra-violet as far as 0.22μ. The following electrodes will give a spectrum with rather weak lines on a continuous background. Make a tube of thin sheet iron 0.25 inch inside diameter, fill with powdered uranium oxide, use as lower electrode, connect to positive terminal and pass six amperes. The negative terminal may be carbon. If the current is reversed a rich line spectrum will be obtained. The amount of ultra-violet light in a source may be photometered by using a Lummer-Brodhun photometer with a glass towards the unknown source which will transmit only the wave-lengths desired. The ultra-violet light is made apparent to the eye by using a screen coated with anthracene instead of white paper.

INDUCTANCES WITH VERY SMALL TIME-CONSTANT.

Measurements of inductances with small time-constants are becoming increasingly important. The method of measurement in any given case depends on the value of the resistance which is associated with the inductance. Measurements of coils of as low inductance as one microhenry have been made. In the method here employed, the inductance to be determined is compared by direct substitution with a standard, whose indutance can be calculated from its dimensions, in an alternating-current bridge, using a frequency of 1500 cycles. The difference in inductance between the coil to be measured and the standard was determined by the change of capacity necessary to reestablish balance in the Anderson's bridge, when the unknown was inserted in place of the standard. The standards used were resistances consisting of two manganin wires stretched parallel to one another at a measured distance apart. In order that no error should be introduced by the small difference in resistance between the standard and the test coil, changes of resistance in steps of 0.1 ohm were obtained by substituting for manganin links, resting in mercury cups, copper links of the same diameter, form and size. For continuous resistance changes of less than 0.1 ohm, a variable resistance was employed, consisting of two straight glass tubes of different diameters, mounted vertically and united at the bottom by a cross tube, filled with mercury. Two copper wires of diameters closely approximating those of the cross sections of the tubes may be raised or lowered in the mercury, giving a continuous variation or resistance, free from any unsteadiness as great as 0.00001 ohm. With this form of instrument the change of resistance is accompanied by a change of inductance almost negligibly small. In the present instance the maximum change of inductance for a change of resistance of 0.1 ohm, as determined by the use of the manganin and copper links was only about ten centimeters. This method of measurement was applied with success to the determination of the inductance of coils of resistances as high as 1,000 ohms. Parallel-wire standards were in every case prepared of the same nominal resistance as the coil to be measured. For the larger values the difference in inductance between the coil and the standard was measured by the change in the setting of a calibrated variable inductance on substituting one for the other. For coils of 1,000 ohms, where a small capacity in parallel with the coil has an appreciable effect on the phase of the current, the balance may also be obtained by varying a capacity shunted around one of the coils.

In coils of 100 ohms or more, the effect of the capacity between the different turns of the winding is usually greater than the inductance, so that the current through the coil leads the impressed electromotive force. For resistances larger than 1,000 ohms, where it becomes difficult or impracticable to prepare standards, whose constants may be calculated, the inductance may be determined by placing the coil as a shunt on a standard of known effective inductance and of about 1,000 ohms resistance. In the measurements of one-ohm, ten-ohm and 100-ohm coils a change of inductance of one centimeter was appreciable, and the measurements made with parallel-wire standards were consistent with those in which the circular form of reference standard was used to about this order of accuracy. With 1,000 and 10,000-ohm coils the difficulties increase. Capacity effects must be very carefully guarded against. Metal surfaces associated with the coils as in the ordinary forms of resistance box are a source of indefiniteness in the constants of the coils. It is also noticeable that the capacity between the windings of coils of such high resistance is not constant, suggesting that the shellac acts as a dielectric with appreciable absorption. The temperature coefficient of the capacity is large and positive. In connection with the measurements on parallel wires of high resistance it was shown, that to obtain consistent values with parallel wire coils of high resistance, it is necessary that the potential of the middle point of the resistance shall be adjusted to the potential of the earth. Otherwise the change in phase observed may be very much in error due to the capacities of the two wires to the ground. The effective inductance of a coil depends on the absolute potential of its terminals. This has the effect that the inductance of the sum of a number of coils in series is not usually equal to the sum of their separate values.

THERMODYNAMICS OF CONCENTRATION CELLS.

The paper was in illustration of the general equation expressing the laws of thermodynamics. A number of possible cases were outlined and two of them were emphasized for illustration and experimental verification. The author showed that it is possible to make a concentration cell with no temperature coefficient. Such a cell may consist of dilute zinc amalgam and dilute solution of sulphate in one leg of a concentration cell, and concentrated amalgam and concentrated sulphate in the other, the electromotive force being 0.002982 volt. This is invariable with change of temperature. This was accomplished by adjusting the concentrations until the temperature-coefficients of the two sides of the cell were equal in value and opposite in sign.

Independent Telephone Toll Lines Connect with Chicago.

Through an order issued in the United States Circuit Court at Chicago on April 21 a traffic agreement is effected between the Illinois Tunnel Company and the Interstate Telephone & Telegraph Company, whose lines surround the city. Thus an entrance is secured to Chicago by the Independent companies.

The Illinois Tunnel Company has in the last few months put into operation in Chicago a new automatic telephone system, which is being extended from the business district outward. It is proposed to connect with the Interstate lines at one or more points along the city limits, first probably at Forty-sixth Avenue and West Twenty-second Street. Through these connections Chicago will be able to get into Independent long-distance telephone communication with cities in at least nine different states. The number of cities and towns reached by the Interstate Company in the state of Illinois alone is 1,234. The traffic agreement was brought about largely by the fact that both the companies entering into it are in the hands of receivers appointed by Judge C. C. Kohlsaat, of the United States Court.

Louisville Loses Telephone Case.

By making permanent an injunction to restrain the City of Louisville, Ky., from putting into effect ordinances calling for reductions in telephone rates, the United States Circuit Court on April 25 decided in favor of the Cumberland Telephone & Telegraph Company in its long drawn out fight with the City.

The ordinances fixed the maximum business telephone rate at $5.50 a month, as against a charge of $7.50. The Telephone Company asserted the rate was confiscatory and in this was sustained by the court.

Electric Company Sued.

The Dean Electric Company has been made defendant in three injunction suits over telephone equipment, which the Western Electric Company declares is being used unlawfully. The bills of complaint against the Dean Company were filed on April 17 in the United States Circuit Court at Cleveland, O.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

Good Boiler Practice with Buckwheat Coal.

In a recent issue of the *Engineering Digest* is given an interesting summary of the boiler practice with buckwheat anthracite coal at the power station at Jersey City, N. J., which supplies the power for the operation of the electric trains in the McAdoo tunnels under the Hudson River.

This station is called upon to supply a load fluctuating momentarily from 8,000 to 16,000 kilowatts and swinging from 1,500 kilowatts in the early morning hours to 13,000 on the morning and evening peaks. Current is supplied by two 6,000- and two 3,000-kilowatt generators, driven by Curtis turbines, to supply steam for which eight Babcock & Wilcox boilers of 900 rated horsepower each have been installed. Some of their dimensions and proportions are as follows:

Water-heating surface per boiler, square feet	9,128
Grate surface per boiler, square feet	190
Water-heating surface per square foot grate surfare, square feet	48.05
Total rated boiler horsepower	7,200
Total rated capacity of generators, kilowatts	18,000
Maximum sustained capacity of generators, kilowatts	28,000
Boiler horsepower per kilowatt, rated	0.40
Boiler horsepower per kilowatt, maximum	0.26
Water-heating surface per kilowatt, rated, square feet	4.06
Water-heating surface per kilowatt, maximum, square feet	2.61
Grate surface per kilowatt, rated, square feet	0.084
Grate surface per kilowatt, maximum, square feet	0.054

It was believed by John Van Vleck, its designer, that a station thus of necessity liberally supplied with grate surface could be run upon No. 3 buckwheat, although none of the large power stations in that vicinity are being so run, and it is doubtful if it is being done elsewhere by a plant carrying a load of this magnitude and with this degree of variation.

A proposition was submitted by the McClave-Brooks Company, of Scranton, Pa., in which it agreed to burn No. 3 buckwheat, without the formation of clinker, to keep the boilers running at the required capacity, with a low per cent of carbon in the ash, and to burn thirty-five pounds of this coal per hour per square foot of grate surface with not over 2.5 inches water pressure of air in the ashpit.

In accordance with this agreement the furnaces were reconstructed. Each furnace has three arches, so spaced that the area between them is sufficient to allow the products of combustion to pass through under slight compression, and placed sufficiently high above the fire to allow the complete combustion of the gases before they are discharged through the openings between the arches upon the cold tubes.

The grate used is what is known as the McClave No. 4. This grate has been designed for the burning of small grades of anthracite, allowing a strong undergrate draft to be used without disarranging the fuel and throwing it about in ridges and mounds all over the surface of the fire bed. It has a uniform mesh of one-eighth inch on the surface of each bar.

The grate is ten feet in depth from the dead plate to the face of the bridge-wall, made up of five rows of bars dumping backward, the center tie and four rows of bars dumping forward. Each boiler is served by two furnaces separated by a division wall supporting the arches. Each furnace is ten feet deep by nine feet six inches wide in the clear and has three sections of grates and three fire doors.

Starting with, perhaps, two inches of live coal, the fires are allowed to build up until in the course of six to seven hours they will have attained a thickness of some twelve to fourteen inches, two-thirds of which will be ash and only the top part live coal. The cleaning is done between the peaks. The air pressure used is from one-half to five-eighths inches of water in the ashpit, with a light load, and one-eighth inch suction in the furnace. After the fire gets to be four or five inches thick, it is blown with about two inches of pressure in the ashpit, which gives a balanced condition in the furnace. When the fire is at its thickest, a blast of two and one-half inches is used. The average rate of combustion is twenty-five pounds per square foot of grate and the maximum thirty-six pounds. At this average rate of combustion the load is carried with five boilers in active operation with one blanked in reserve for emergency.

The pressure carried is from 180 to 185 pounds with 125 degrees of superheat. Each boiler has a separate Green economizer, which heats the feed water to 240 or 250 degrees.

The cost of operation has been running down steadily since the plant was started, and has reached the remarkably low figure of less than 0.42 per cent per kilowatt-hour for current at the switchboard, including the cost of water, supplies, wages and coal. These cost, respectively, 0.020, 0.035, 0.175 and 0.190 cent per kilowatt-hour. The average total cost for eight months was 0.443 cent per kilowatt-hour. The No. 3 buckwheat costs about forty-three per cent less at the conveyor siding of the station than No. 1 buckwheat coal. One of the units is fitted with a Venturi meter, Richardson coal scales, Westover CO_2 recorder, etc., and produced upon test the results in the accompanying table, the test being made with No. 3 buckwheat.

RESULTS OF THREE TESTS.

Date of test (1910)	June 22-23	July 5-8	July 20-21
Duration, hours	24	72	24
Moisture in coal, %	4.6	2.75	3
Total ash and refuse in dry coal, %	29.5	21	27 avg.
Dry coal fired per hr., lb.	4,502	4,126	4,577 avg.
Dry coal per hr. per sq. ft. of grate, lb.	23.7	21.7	24 avg.
Equivalent exaporation from and at 212° F., lb. per hour	30,899	28,988	35,857 avg.
Do., per sq. ft. of heating surface, lb. per hour	3.38	3.17	3.93 avg.
Steam pressure, gauge, lb. per sq. in.	188	185	180
Feed-water temperature, deg. F.	252	226.4	243
Draft under grate, in. of water	0.5 to 1	0.5 to 1.75	0.5 to 2.5
Superheat at boiler (approx.), deg. F.	125	125	125 avg.
H.P. developed	901	840	1,039
Per cent of builder's rating developed	100.1	93 3	114 avg.
Equivalent evaporation from and at 212° F. per lb. coal as fired, lb.	6.47	6.82	7.59 avg.
Do., per lb. dry coal.	6.86	7.02	7.84 avg.
Do., per lb. combustible	8.63	8.9	10 84 avg

The Dauphiné-Centre Transmission Line.

The Dauphiné-Centre transmission line, extending between Grenoble and Saint-Etienne, France, a distance of about seventy-three miles, has the distinction of being the first high-tension line in France using aluminum conductors and in addition is notable as part of a well arranged hydroelectric system.

This line with its generating stations at Pont Haut and Eau d'Olle unites with lines receiving hydroelectric power from entirely different sources, so that the waterpower is used to the best advantage. In summer when the water supply feeding the hydroelectric plants on the plains is scant, the melting snow in the Alps provides ample power which is transmitted through this recently constructed line.

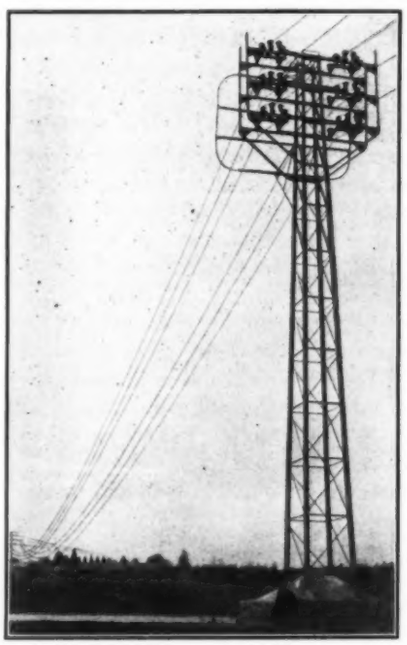
The Dauphiné-Centre system was put in operation at 30,000 volts in April, 1910, and was raised to its normal voltage of 60,000 in September of the same year. Later connections were made with the other sections of systems with which it is at present operating as a section.

The line itself has two three-phase circuits each capable of transmitting 4,000 kilowatts at 60,000 volts. At first it was the intention to use copper exclusively but later aluminum was adopted except at certain points, where owing to the necessity of spans of more than 500 feet in length it was thought advisable to use phosphor-bronze. Through the greater part of the line the spans measured 230 feet, each one of the six aluminum cables being composed of nineteen strands with a total breaking strength of twenty-two kilograms per square millimeter. The phosphor-bronze cables used for the longer spans have a breaking strength of eighty kilograms per square millimeter. All splicing is done with aluminum tubes. The aluminum wires are eighty-eight square millimeters in cross section and the phosphor-bronze one hundred millimeters.

Three-petticoat insulators of the Parvillée type are used, the sections being cemented together so that each is sealed to the next one of smaller size. Tests were made with the provision that the larger section should withstand 70,000 volts for a quarter of an hour, and each of the other sections 60,000 volts for the same length of time Mounted and sealed together, the three petticoats withstood from 130,000 to 137,500 volts without arcing. Tests made in a ten-millimeter rain at forty-five degrees produced discharges at 93,000 to 93,500 volts and an arc at 118,000 volts. From a mechanical standpoint the insulators are capable of resisting a pull of 950 kilograms.

It might also be mentioned that the three insulators which are superposed are not set on the same vertical line, but slightly to one side, so that the rust from any supporting bolt will not fall on the insulator below it and diminish its insulating qualities.

Towers of trellised iron work provided with oak cross-arms carry the lines, making use of one insulator per line on straight stretches, and two for



TRANSMISSION LINE AND TOWER OF THE DAUPHINÉ-CENTRE LINE.

equally distributing the strain, where turns are made.

At the crossing of the Rhone, which is one of the most interesting points in the installation, the span is 990 feet, the pull on the pole, exercised by the two three-phase lines amounts to approximately 22,800 kilograms. The towers weigh, together, twenty tons, one of them being eighty-six feet in height and the other forty-three feet. The higher of these two towers is shown in the accompanying illustration, which also gives an idea of the method of construction of these towers.—*Abstracted and translated from La Lumiere Electrique.*

HOW TO REMOVE LEAD SULPHATE FROM LEAD PLATES.

BY PAUL F. TROUT.

In storage-battery practice, one is often confronted with the perplexing problem of removing a coat of hard lead sulphate from a sheet or plate of metallic lead where it is either undesirable or impossible to remove it by the crude method of scraping. The following is a method which I have found to be highly efficient and satisfactory. In this case, the lead plates had become thickly coated with sulphate by precipitation. First, they had been accidentally allowed to stand in fresh distilled water until a thick coat of lead hydroxide had formed, then they had been transferred to a bath of dilute sulphuric acid where a firmly-adhering coat of lead sulphate was formed in a very short time.

I first washed the acid off in water and then put the plates to soak in a bath of ammonium acetate, ammonium hydroxide and distilled water in these proportions: three parts of water, one part of ammonium hydroxide and one part of ammonium acetate, by weight.

After the plates were clean, they were washed thoroughly and put in a bath of sulphuric acid of specific gravity 1.100. Then after they had been in the acid bath an hour, they were taken out and dried.

The ammonium acetate bath will retain its strength through much work and when it does begin to weaken, its strength can be maintained for a time by the further addition of ammonium hydroxide.

The operation of washing the lead acetate, a very soluble salt compared to lead sulphate, from the plates prior to immersing them in the sulphuric acid bath must be done thoroughly or the lead sulphate will be re-precipitated, in which case, however, it can very easily be redissolved in the ammonium-acetate bath. About four days will be required to completely dissolve a coat of lead sulphate.

Wireless messages have been exchanged between Marseilles and a vessel in the farther end of the Red Sea, the distance being about 2,500 miles. While this distance has been greatly exceeded it is announced as a record for a station of this size.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

ELECTRIC STREET LIGHTING.—V.

BY ALBERT SCHEIBLE.

LUMINOUS OR METALLIC FLAME ARC LAMPS.

When the cost of living was increasing steadily during the past decade, the American public, although protesting in various ways, bowed to the inevitable in accepting the advance of living expenses in so far as it pertained to the cost of food, clothing, fuel, building materials or rent. But whenever any increase has been proposed in the charge for a public utility service, such as the furnishing of street lights, the public has not looked upon this advance with the same equanimity. When street-lighting contracts expired, the city authorities have usually been expected to bargain for the lights at better terms than those secured five or ten years earlier, even though the cost to the electric light company of maintaining its existing street-lighting service might actually be much greater than it was at the time the expiring contract was made.

The very evident increases in the costs of labor and fuel, the more expensive maintenance implied by more rigid regulations of one kind and another, the making of an ample allowance for the depreciation which had too often been underestimated—all these easily verified additions to the cost of the street lighting have commonly been ignored. Too often the central station has been expected to either offer the same light at a lower figure or else to give more of it for the same price when seeking a new street-lighting contract.

Fortunately for our electric light companies, the 450-watt open arc lamps which the original contracts implied did not give the most economical distribution of light that could be had from this wattage. Hence the change to 325-watt inclosed arc lamps enabled them to show a somewhat better light distribution as well as a steadier lighting at a decided saving in the costs of both fuel and maintenance. But when the second series of street-lighting contracts were made (those in which alternating arcs of definite wattage had been substituted for the original open arcs of nominal 1,200 or 2,000 candlepower) no adding of another globe could repeat the decrease in operating costs. The large alternating-current generators and stationary transformers were too efficient a distribution system to admit of any substantial saving of losses in them and the use of inclosing globes had already reduced the labor of trimming and the cost of carbons to a comparatively small item.

As for the lamps themselves, even the old open arc types (although too often rendered unsteady by faulty mechanisms) had practically reached the limit of efficiency for the pure carbon arc in which the light emanates almost wholly from the white-hot tips of the carbons. In such lamps only a small portion of the light comes from the arc proper, i. e., from the vapor conductor spanning the gap between the carbons. The voltage spent in bridging this gap was not used economically even in the open arcs with their one-eighth-inch gaps and much less so in the inclosed arcs in which the arc itself is about three times as long. Hence with both types of lamps there still remained the possibility of improving the efficiency by getting the voltage spent in bridging the gap to produce light also.

Thus, if instead of using carbon as the positive electrode we had some conducting material which would be made luminescent by the current when this has carried it into the arc, we should have a much more efficient source of light. Materials suitable for such electrodes would have to be fair conductors when cold, hence the choice is quite limited. The most promising ones, as pointed out by Dr. Steinmetz, to whom this type of arc lamp is due, are magnetite (a black oxide of iron found in nature as a magnetic ore) and titanium carbide, each usually mixed with other ingredients. With the current steadily flowing in one direction, the other electrode can be of copper, phosphor bronze or similar materials which theoretically are not consumed at all but which must be large enough to carry off and dissipate the heat. The active electrode (at present usually composed chiefly of magnetite and other metallic oxides) can be made large enough so that it will not be consumed by heat evaporation but will only be used up at the slower rate required for supplying the arc vapor. This accounts for the long life of the electrodes in the "luminous arc" lamps, sometimes also called "metallic flame" arcs.[1]

Just as the Welsbach mantle, in which various chemicals are heated by a non-luminous gas flame, is much more efficient as an illuminant than the fish-tail gas burner, in which the carbon in the gas itself is rendered incandescent, so the heating of the metallic oxide in the formerly non-luminous arc means increased efficiency over the simple carbon arcs. Hence, as was recently shown in figures issued from the University of Illinois, the 6.6-ampere series magnetite arc lamp requires only half as much electrical energy for a given number of candlepower-hours as the old 9.6-ampere series open arc lamps. Although as a rule lower ampere lamps are less efficient, curves prepared by W. D'A. Ryan show that both the candlepower and the distribution of light from a

1 The terminology of arc lamps, and particularly of those lamps in which materials are fed into the arc to render the latter luminescent, is sadly in need of standardization. Dr. Steinmetz in his writings persists in using the term "luminous arc" only for those lamps in which the material made luminous in the arc gap is fed into it by electro-conduction, while others prefer to call these "metallic oxide" or "metallic flame" arcs. Some have even suggested the term "metallic arcs," though this would evidently include the mercury-vapor lamps.

On the other hand, E. L. Elliott suggested five years ago that the term "luminous arc" should include those lamps in which the arc is supplied with material fed into it by heat evaporation from one or both electrodes; i. e., what have commonly been called "flaming arc" lamps. The German designation of "display-carbon arcs" is suggestive, though the writer perfers the term advocated by J. G. Pomeroy—"impregnated-carbon arcs."

four-ampere (272-watt) magnetite arc are substantially the same as from a 6.6-ampere (325-watt) inclosed arc.

Of course these luminous arc lamps require either a direct-current generator (for which purpose some of the large size Brush arc dynamos, so-called "125 lighters," have again been restored to the market) or a rectifier for converting the available alternating current into a direct one. Sometimes, as at Harrisburg, the direct-current dynamos are themselves driven by alternating-current motors at substations, instead of having rectifiers of smaller dimensions. For the latter purpose a form of mercurial arc is commonly used, the durability of the rectifier tubes having been gradually improved to reduce their original shortcomings. Allowing for the losses in these rectifiers and the larger central-station capacity needed because of their low power-factor, the

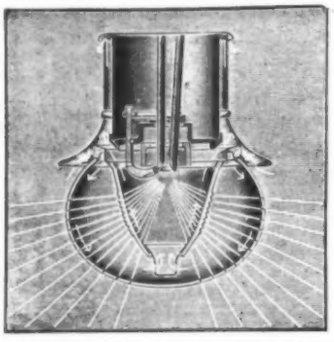


FIG. 1.—ARC LAMP WITH PRISMATIC GLOBE.

metallic oxide or luminous arc lamps are still believed to show a decided saving to the central station over the inclosed arcs, owing partly to the lower wattage and partly to the reduced cost of maintenance. Consequently they have proven a boon to central stations who during the last few years have been called upon to quote still closer terms than formerly for their street lighting.

Being allied to the mercurial arcs, the metallic oxide lamps have a small percentage of the ultra-violet rays which are harmful to the human eye if the latter is exposed directly to the same for any considerable length of time. The simple carbon arcs were practically free from these rays, hence they could safely be used without glass globes of any kind, but glass globes are needed with the metallic oxide or luminous arc lamps to sift out the ultra-violet rays. In Europe the improbable danger from these rays seems to have been greatly magnified and the unsteadiness of early types of these lamps gave them such a setback that they never got a real foothold. This unsteadiness was due partly to the use of the magnetite without a steadying admixture of other ingredients like chromium oxide and partly to an excessive size of the electrodes, which caused the arc to travel round and round and often almost die out. Both of these shortcomings were soon overcome in this country, one manufacturer even making the non-consuming terminal so small as to have it renewed at each trimming (every 250 hours) thereby avoiding irregularities due to the gradual change in shape of the heated tip.

IMPREGNATED CARBON OR "FLAMING-ARC" LAMPS.

While American manufacturers were busy lengthening the life of the carbons in their arc lamps by means of inclosing globes and improving the methods of distributing current to the same, Europeans clung to the open arc lamps, improving both the mechanism and the purity of the carbons. In doing so they did not take up the use of the alternating current; for as this meant heating the carbon tips alternately, it lowered the temperature of the tips from which the bulk of the light emanated and hence meant a lower light-giving efficiency than with the direct current. In America this reduced efficiency was excused because of the saving in labor and the advantages gained in economical distribution by using large alternating-current generators and stationary transformers.

But nevertheless, in Europe, where labor is so much cheaper, the lowering of the efficiency due to the lengthening of the arc by an inclosing globe and to the use of the alternating current, was deemed prohibitive. Instead of following the lines of American practice the Europeans and particularly the Germans strove to improve the efficiency of the direct-current open arc lamps by utilizing the previously wasteful part of the arc-lamp voltage.

For this purpose Bremer started the practice (experimentally in 1899 and commercially some five years later) of mixing other substances with the carbons, allowing these impregnating materials to be vaporized, by the heat of the carbon tips as the latter were consumed. In thus feeding materials into the arc by heat, the carbon which supplies the heat (for the other materials need not be conductors of the current) forms only a part of the positive electrode and is much more rapidly consumed than the metallic oxide electrode which Steinmetz introduced later on in his "luminous arc" lamp. Consequently the impregnated carbon or so-called "flaming arc" lamp required the daily trimming which the Americans had sought to avoid.

In most of the early types of impregnated-carbon lamps the arc is formed between the lower ends of two inclined carbons converging towards each other (as shown in Fig. 1), thereby allowing any slag or other impurities to drop out of the flame instead of settling upon one of the carbons. The arc is substantially horizontal and usually under a reflecting disk which shields the mechanism of the lamp from the heat of the arc, the light being thrown largely in a downward direction. Consequently, while these "flaming arc" lamps (or,

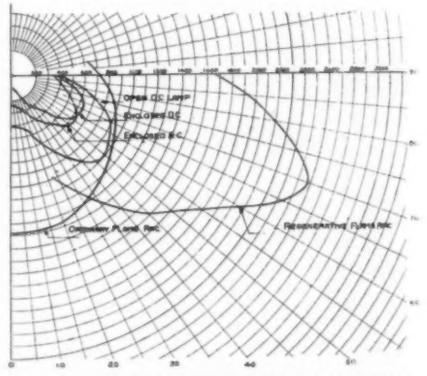


FIG. 2.—LIGHT DISTRIBUTON OF VARIOUS TYPES OF ARC LAMPS.

as the Germans called them, "display-carbon arc lamps") were promptly recognized as well suited for outdoor mercantile advertising purposes, American arc-lamp experts at first thought them to be out of the question for any general street lighting.

Instead of sharing this conclusion (based partly on the high cost of carbons and maintenance, and partly on the poor light distribution obtainable from such lamps when hung only fifteen or twenty feet above the ground according to the common American arc-light practice) the Europeans soon began to use their impregnated-carbon lamps for street lighting, placing them at ample heights for obtaining a better distribution of the light. During the past year some manufacturers have also endeavored to improve the light distribution by using inner prismatic globes, one arrangement being shown in Fig. 1. Others have been developing lamps with the carbons vertically above one another as in the older types of

are lamps, thereby also securing a more horizontal light distribution.

"REGENERATIVE" IMPREGNATED-CARBON LAMPS.

Owing to the smoke and soot caused by the combustion of the impregnating materials, the life of the electrodes cannot be lengthened by using a simple inclosing globe as is done with the plain carbons. However, if the smoky air is passed through a soot-depositing chamber, the same can be used over again, thereby decreasing the supply of fresh air. This is done in the so-called "regenerative" arc lamps which therefore have a much longer life of carbons and which, as shown in Fig. 2, also give a more horizontal light distribution. These require only a single trimming in from 70 to 100 hours, reducing the cost of both labor and carbons, and yielding an unusually high light-giving efficiency.

With these, as with all impregnated-carbon lamps, the color of the light can be varied by changing the impregnating chemicals, of which the more commonly used ones have been calcium and potassium salts giving a yellow or golden tint. This tint is very pleasing in any intense lighting, though not as effective at lower intensities of illumination as the practically white light of the plain carbon or magnetite arcs. To make the light more white the impregnating salts sometimes include cerium fluoride, a byproduct of the Welsbach mantle industry.

(To be continued.)

Chicago Section, Illuminating Engineering Society.

A meeting of the Chicago Section of the Illuminating Engineering Society was held on April 20 in connection with luncheon at the Kuntz-Remmler Restaurant, Chicago. Charles R. Gilman, of Milwaukee, Wis., chief electrician of the Chicago, Milwaukee & St. Paul Railway Company, presented a paper on "Recent Developments in Train and Car Lighting."

Mr. Gilman's paper dwells on the progress achieved in the electric lighting of railroad passenger trains. Improvements in this illumination have been brought about largely on account of operating necessities. One manifestation of progress has been the use of shades over bare lamps, both to reduce their glare and to improve the appearance of the car. Another is the more general use of efficient reflectors; their use permits a material reduction in the number of lamps required to illuminate a car and at the same time hides the great intrinsic brilliancy of the lamps from the eye. Mr. Gilman cites numerous instances in which the number and size of the lamps was reduced through the intelligent use of reflectors over them. The introduction of tantalum and tungsten lamps has permitted further economies, particularly in the first cost of generating and storage equipment required. In the head-end system it has resulted in the reduction of the voltage from 110 to sixty-four volts, with corresponding reduction in the size of auxiliary storage batteries and about forty per cent reduction in the load on the generator. Many of the fixtures formerly in use were of faulty design. Some of these have been rebuilt in the railroad shops with excellent results, both as to the resultant illumination and the efficiency of the unit. Dining cars have been troublesome ones to illuminate properly. An improvement in sleeping cars is the introduction of berth lamps. In coach lighting no very radical changes have taken place except to use less lamps than formerly and to equip these with reflectors. These are usually mounted under the lower or side deck, although some railroads also put in lamps under the center deck. Mail-car lighting had formerly been neglected. A flat trough reflector had been chosen by the postal authorities. This was subsequently changed to individual reflectors over each lamp and the number of lamps reduced, twelve-candlepower tungsten lamps being also used in place of sixteen-candlepower carbons; the total wattage was reduced to less than one-fourth- and, although the candle-foot illumination was somewhat reduced, the resultant lighting was more satisfactory to the mail clerks.

The discussion of the paper consisted largely of questions asked by Messrs. Scheible, Naylor, Aldrich, Lloyd, Vaughn and Keech. To each of these Mr. Gilman replied directly. Thus he stated that all illumination tests have been made on a horizontal plane thirty-three inches above the floor; the oblique reading plane had been advocated by some, but it was felt that more consistent results could be obtained on the horizontal plane and this had been standardized. The requisite amount of illumination has not yet been standardized. Frosted lamps are not used because of the difficulty of cleaning them properly; there is a movement to simplify fixtures so as to facilitate cleaning; the present bare lamps will probably be covered by lightly etched bowls. Lighting by compressed oil gas has not been driven out, in fact, Mr. Gilman regarded it as quite satisfactory and not particularly hazardous. He gave some comparative figures of cost of equipment for electric train lighting by the head-end and car-axle systems; each car of the latter requires an equipment costing (outside of lamps and fixtures) about $1,500; the generating equipment by the head-end system for a seventeen-car train costs about $4,000, as against $25,000 for the axle system. The interior finish in modern railroad cars is usually of dark mahogany or oak, though there is a tendency to adopt lighter colored finish, especially for the ceilings, as the dark colors have absorbed too much light.

F. A. Vaughn called attention to a psychological defect in some of the modern dining cars where excellent illumination is furnished on the tables by side lamps but the upper part of the car looks dismal from the absence of center deck lamps. Mr. Gilman stated that he had found it necessary to provide center lamps for a number of dining cars for this very reason although the table illumination was entirely adequate.

A. J. Sweet spoke of the decided movement for better car lighting which is making itself felt on many railroad systems. He gave Mr. Gilman credit for being one of the leaders in this field. There are three important requirements to be met in car lighting: first is efficiency so as to reduce the size, weight and cost of the generating and storage equipment; second is adequacy of illumination at all points in a car; third is the avoidance of glare. Mr. Sweet had recently conducted a series of tests in a railway car equipped first with bare lamps and then with properly shaded lamps and reflectors; the illumination with the latter was over twice that with the bare lamps and the glare was practically eliminated. He was glad that the horizontal plane was generally accepted as the plane of reference for illumination measurements, since it is the most convenient and enables us to form a good opinion of the actual illumination.

Prof. A. M. Wilson, of the State University of Kentucky, advocated that the railroads unite in conducting a series of tests on the various systems of electric lighting and the best ways of utilizing the light. He also indorsed the use of the horizontal plane for illuminations since it is quite easy to refer from the horizontal to any inclined plane desired.

At the next meeting of the Chicago Section, which will be held on the evening of May 18, Charles A. Luther, illuminating engineer of the People's Gas Light & Coke Company, will present a paper on "The Illumination of the People's Gas Building." This twenty-story office building is the largest structure illuminated by gas. The meeting will probably be held in that building and will therefore afford an excellent opportunity to study what is being done in gas lighting with the most modern and efficient gas lamps.

TELEPHONY—TELEGRAPHY, and WIRELESS.

CONSTRUCTION OF THE WILMINGTON-WASHINGTON TELEPHONE AND TELEGRAPH CONDUIT.

PART OF THE UNDERGROUND TOLL-LINE SYSTEM BETWEEN BOSTON AND WASHINGTON.

Mention has been made in these columns in previous issues of the construction by the American Telephone & Telegraph Company of a series of underground conduits which, when completed, will form an all-underground cable route of about 470 miles between Boston, Mass., and Washington, D. C. These cables are being installed in accordance with the far-seeing and progressive policy of the company to provide means for long-distance communication by telephone and telegraph between the principal traffic centers that will eliminate the troubles and interruptions from storms to which pole lines are so subject. The entire project is a gigantic one that has engaged the attention of the company's executive and engineering departments for some time. Of particular interest in this extensive undertaking are the new conduit-construction methods employed and the large number and variety of circuits that the underground cables will carry.

At New York is the central dividing point in this long stretch of conduit. Several sections of the New York-Boston conduit are completed; one gap of about 125 miles has to be filled between New Haven, Conn., and Providence, R. I. Of the New York-Washington conduit, the New York-Philadelphia section of about 87 miles has been in service for some time. From Philadelphia it had been extended to Wilmington, Del. The 92-mile conduit between Wilmington and Washington was built last fall. For its construction several novel methods were employed; these form the subject of the present article.

FIG. 1.—TRENCH-DIGGING MACHINE.

FIG. 2.—WROUGHT-IRON SHIELDS FOR PROTECTING DUCTS ON BRIDGES.

In a previous issue (November 19, 1910, page 1050) the general features of the Wilmington-Washington conduit were described. The general route followed is that along which Professor Morse, inventor of the telegraph, had proposed to lay an underground telegraph line in the pioneer days of the telegraph. The line is built along the public highways with their undulations and numerous railroad and river or creek crossings. Of the latter, seventy-five bridges were crossed, each constituting a special problem of its own. Careful preliminary surveys of the entire route with special attention to difficult points permitted the entire construction to be planned in detail, so that it was executed in exceptionally fast time and without a hitch.

The construction work was divided into three sections, as follows: section 1—from the southwesterly city limits of Wilmington, Del., to the west bank of the Susquehanna River at Havre de Grace, Md.; section 2—from the west bank of the Susquehanna River at Havre de Grace, Md., to the northeasterly city limits of Baltimore, Md.; section 3—from the southwesterly city limits of Baltimore, Md., to the northeasterly line of the District of Columbia.

For the excavation of the first of these sections a trenching machine (Fig. 1) was used. This did as much work as a large gang of laborers; its average daily work amounted to the complete excavation of 1,000 feet of trench, eighteen inches wide by three feet deep. It was possible to work the machine so as to dig three lineal feet

of trench for each minute of actual working time; it left the trench clean and ready for the ducts, and piled the excavated material on one side; an engineer and two assistants operated the machine.

For the other sections the excavation was made by first plowing to a certain depth with a trenching plow drawn by two mules or horses; the earth was then shoveled out by the laborers and the plow passed through once more, these operations being repeated until the requisite depth was reached.

Along most of the conduit run in the open country the ducts were laid directly in the ground without even a plank at the top or bottom. Where there was likelihood of disturbances from subsequent digging, protection was placed about the ducts. Most of the conduit received four ducts except where it runs through towns, where five, six or more ducts were laid. Creosoted pump-log ducts were used throughout. These ducts have a length of seven feet each and a bore of three inches. They are of yellow pine thoroughly impregnated with dead oil of coal tar forced into the pores of the wood under such pressure as to absorb fifteen pounds of oil in each cubic foot of wood. These ducts are very durable. Pump-log telephone ducts laid in Philadelphia in the early eighties were dug up in 1907 and found to be practically intact. They were later used in another underground construction.

Over 300,000 pieces of duct were required for the Wilmington-Washington line. As shown in Fig. 2, the ends of the ducts fit together, making a tight joint without cementing. This feature, as well as the long length of each piece of duct, promoted speed in laying the ducts. In doing this work, the joints were staggered and the ducts laid two side by side and two rows high, thus getting a maximum strength without external protection against displacement.

In refilling the trench, about six inches of earth was first shoveled on and around the ducts, and carefully tamped. A concrete roller weighing about 1,000 pounds was then rolled in the trench. Another six-inch layer received similar treatment, this being continued until the trench was filled.

Fig. 3 shows the roller used for packing the backfill. On section 2 the earth was filled in loosely and crowned about six inches over the trench; then a steam traction roller (Fig. 4) weighing about ten tons was rolled back and forth over it till it was thoroughly compacted and smooth.

Many of the roads between Baltimore and Washington are improved highways, a fourteen-foot strip of macadam paving occupying the center of the road. Some of the roads had been oiled and it was feared that the work on the trenches would seriously impair their surface. Therefore, strips of burlap, between 3,000 and 4,000 feet in length, and eight feet wide, were used to cover the improved roads while the work of trenching was going on. The earth from the trenches was thrown upon this burlap. After refilling the trench the burlap was removed and transferred to another section, leaving the road surface uninjured.

Fair digging was generally encountered and the rock gang, so called because its function was to remove large rocks and ledge from the trenches, was able to remove all such obstacles without delaying the progress of the work.

All the manholes along the Wilmington-Washington conduit are entirely of

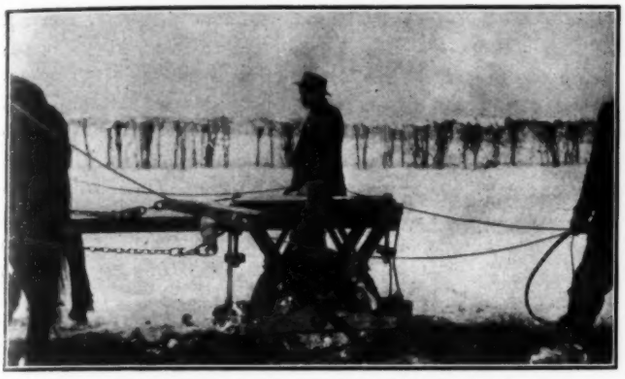


FIG. 3.—CONCRETE ROLLER FOR RAMMING BACK-FILL.

FIG. 4.—STEAM TRACTION ENGINE FOR ROLLING TRENCH.

FIG. 5.—CONCRETE SLABS FOR MANHOLES.

FIG. 6.—CONCRETE COVERS FOR MANHOLES.

reinforced concrete. They average about 500 feet apart. To facilitate the building of such a large number of concrete manholes as would be required, a concrete plant was established at Baltimore, where a building was rented along a railroad siding. This plant was put into operation some time before actual construction work began on the trenches, so as to give time for the manhole sections to set properly before shipment to the place where they were to be installed. Forty men were employed at the plant and 400 manhole sections, sufficient for twenty-five complete manholes, were molded each working day. About 1,000 manholes were required for the work.

The manholes are of novel construction. They consist of thin slabs of concrete, reinforced with No. 10 three-inch mesh standard expanded metal, and joined by heavier key-blocks. The manholes are of barrel-shape cross section, the inside dimensions being three feet wide by four feet six inches long and three feet high in the clear. The walls consist of four concrete slabs, three inches thick. These are shown in Fig. 5. The roof is formed by two concrete slabs four inches thick. The flanged cover is also of reinforced concrete, twenty-four inches in diameter (Fig. 6). When in place, the manhole cover is twelve inches below the highway grade. A concrete post, four by six inches, is set two feet out of the ground, at the side of the road and opposite each manhole, so that the exact position of the latter may be readily ascertained. Upon each post is marked the number of the manhole and its exact distance from the marker.

The running of a conduit line over a bridge is a difficult problem. It must not interfere with traffic and at the same time it must be protected from any possible damage in a thoroughly effective way. The usual method employed for telephone ducts in the past has been to protect the cables by means of iron pipe. This method possesses many disadvantages, chief among them being the fact that within a few years after being laid the iron is liable to rust and disintegrate. For this reason, iron pipe in connection with bridge crossings has been avoided wherever possible. In the case of only six out of the seventy-five bridges on the present work was it found necessary to make use of it. These bridges were of various types with varying conditions and the engineers in charge of the work introduced several new features in construction in carrying the ducts across them.

In many cases this was accomplished by incasing the ducts in a wooden box made of heavy crosoted plank, this box resting on angle irons, and being suspended by iron hangers from the bridge structure, as shown in Fig. 7. Where the conditions made it necessary to suspend the ducts from the side of the bridge, the engineers have swung the conduit on a curve, using iron pipe protected by concrete construction. In some cases angle iron has been laid across the bridge girders beneath the flooring, the ducts running across on wooden blocks placed at intervals (Fig. 8), the whole being protected from mechanical injury by a wrought-iron plate or shield on the top and sides, a new thing in telephone construction. Figure 2 shows some of these shields. This metal shield is for the purpose of protecting the wooden ducts from the danger of being pierced by spikes when repairs are being made on the bridge.

The duplex phantomed cables that are to be used in this conduit line were already described in previous issues, (January 7 and 28, 1911, pages 44 and 197). They will contain seventy-four pairs of copper wires of several sizes, the larger ones being phantomed so that each double pair forms three telephone circuits and eight telegraph circuits. The smaller wires will be used for telegraph service between the cities along the line. On the seventy-four pairs of wires it will be possible to conduct 99 simultaneous telephone conversations and also to send at the same time 296 telegraph messages. The circuits will be provided with Pupin loading coils, of which nearly 10,000 will be used on each cable between Philadelphia and Washington. These will be assembled into cast-iron pots at the factory so that about 400 of these will have to have their cable stubs spliced into the main cable.

The construction work on this new conduit line was under the general direction of Charles H. Wilson, general superintendent of the American Telephone & Telegraph Company. Its immediate execution was in charge of F. A. Stevenson, general superintendent of plant of the same company.

FIG. 7.—METHOD OF SUSPENDING CONDUIT AT SIDE OF A BRIDGE.

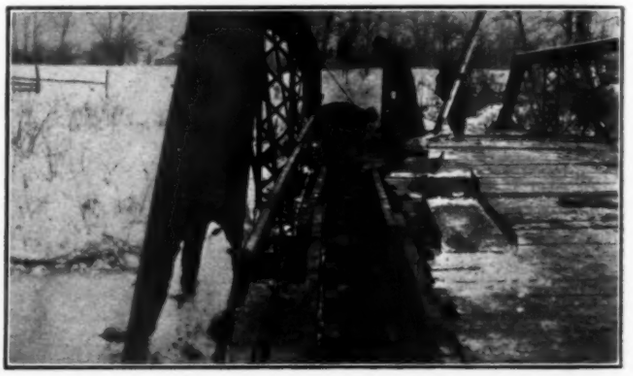


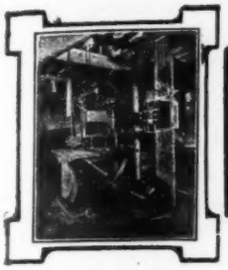
FIG. 8.—LAYING CONDUIT IN FLOOR OF A BRIDGE.

Rangers to Use Telephones.

Rangers in the national forests are to be supplied with portable telephone sets provided with flexible wire which may be quickly and easily run along the ground to isolated points in the forests.

At the season when forest fires are most numerous an extra force of rangers will protect the isolated parts of the forests, laying their telephone lines along the ground as they go.

Exports of copper for the week ending April 20, 14,406 tons. Since the first of the month 22,750 tons have been exported.



Industrial Power

The Electrical Equipment of the Repair Shops of the Chicago Railways Company.

The Chicago Railways Company completed a short time ago a reconstruction and re-equipment of its West Side repair shops which makes this installation especially interesting as an instance of a complete change over from belt drive to individual motor drive with an independent and variable-speed source of power for each machine. Both the machine shops and woodworking shops in this group of buildings are equipped to attend to all the repair work of the company's equipment which comprises more than 2,000 cars of various types. Exclusive of the car barns the area covered by the buildings is nearly 300,000 square feet, and at normal periods from 600 to 700 men are employed in making the current repairs.

The installation is of interest in the first place from a standpoint of size, as it is probably the largest equipment of automatic starters for the control of individually motor-driven metal and wood-working machinery. In the machine shops forty-eight machines were converted to motor drive and twenty-two new motor-driven machines were added. Of the fifty-six machines in the wood-mill twenty-three were newly installed. Those machines which were formerly belt driven: lathes, punches, shears, milling machines, planers and other types of both heavy and light machinery running at various speeds, were arranged so that starting and stopping was accomplished by the pressure of a button, and speed control was obtained by the turning of a handwheel within the operator's reach. The buttons for stopping and starting may be seen in Fig. 5 just above the starting panel and again in Fig. 1. The hand wheel for speed regulation is well shown in both Fig. 4 and Fig. 6. The motors, made by the Reliance Electric and Enginering Company, make use of the Lincoln principle of obtaining variations in speed by moving the armature along the shaft into regions of stronger or weaker field, according as the operator wishes to decrease or increase the motor speed. This allows the use of automatic starters of the same type as those used for starting constant-speed motors. No provision need be made in the starter for speed regulation. All of the starters, of which there are now about 100 in use, are of the Schureman type and were furnished by the Cutler-Hammer Manufacturing Company.

FIG. 1.—TENONING MACHINE DRIVEN THROUGH LONG SHAFT.

It may be seen from the illustrations that, owing to the construction of the belt-driven machines the change over was in some cases a little difficult and it was not always possible to so select the place for the motor that the operator could control the speed by a direct handwheel. An instance of this is shown in Fig. 2, illustrating a forty-eight-inch car-wheel borer on which a 7.5-horsepower variable-speed motor has taken the place of belt drive. In this case the operator's handwheel turns a geared shaft, the end of which is fitted with a sprocket and chain, arranged to turn another small shaft seen directly over the motor. This, in turn, is connected by a link chain to the wheel which slides the armature back and forward along the shaft, varying the speed. An auxiliary motor is used in this case to drive the feed.

In Fig. 6, which is a typical illustration of the arrangement of the motor-driven lathes through the shop, may be seen the method of mounting the motors on the machine by means of heavy strap-iron brackets. While it may appear that this arrangement gives a rather high center of gravity to the driving parts the bracing is suf-

ficiently strong to guarantee smooth running at all except the very highest speeds. The illustration also shows very well the compactness of arrangement which is possible. An inclosed case at the left of the machine contains the automatic starter, the leads to the starting buttons being brought up through iron conduit so that the starting and starting means are at the hand of the operator. It might here be noted that in cases of machines having long beds or in work where the operator may be in either one of two positions, two sets of buttons in parallel are provided or for special cases another circuit might easily be added.

Fig. 1 shows a fifteen-horsepower motor driving a tenoning machine in the woodworking shops, this being one of the instances where the motor mounted on the floor drives the machine through a long shaft, and where the automatic starter is mounted on a convenient post. The automatic buttons are at the front of the machine in the middle. A case in which the motor has been set on the floor, driving through a belt, may be seen in Fig. 7, illustrating a keyseat milling machine driven by a five-horsepower, 500 to 1,500 revolution-per-minute motor. Here the construction of the machine permitted the starter to be mounted directly on the frame and control buttons are placed conveniently directly on the conduit leading to the supply circuit.

One of the upright drills using a two-horsepower 400 to 2,400 revolution-per-minute motor shows still another method of mounting the motor, in which instance it was simply put in place of the lower cone pulleys, being connected to the upper cones by a belt. The iron braces supporting the motor form an excellent mounting for the starter and the entire arrangement takes up no more floor space than was required with the belt-driven machine. Should more power be required than can be transmitted by the present belt arrangement it would be a simple matter to provide wider pulleys.

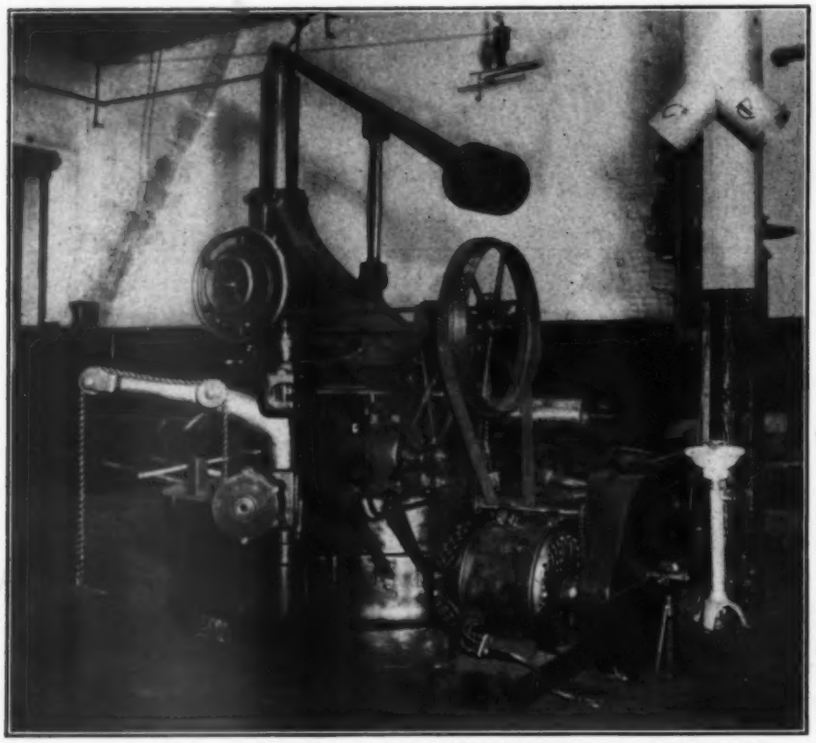


FIG. 2.—CAR-WHEEL BORER WITH SPEED CONTROL THROUGH SHAFTS AND SPROCKETS.

There were in laying out this new motor installation a number of points to be considered beyond the customary aim of equipping the shop to do the necessary machine work with as little loss of time and at as little expense as possible. One of the things to be desired in a shop of this class is speed, as equipment must be returned to service as quickly as possible, even if the extra speed should cause a higher repair cost. With the present arrangement the time of making repairs has been reduced, as has also the power cost. A problem which came up at the beginning was to do away as far as possible with wiring in the vicinity of the machines, as all the motors are driven by the 550-volt direct-current grounded circuit, power being taken from the railway lines. It was highly desirable to have as little wiring about the machine as possible, both to protect the workmen from injury and the machines from accident, so the method chosen has reduced the matter to the greatest simplicity possible.

The circuits in which the buttons are connected, and by means of which the automatic starters are actuated, carry about one-sixth ampere and are practically the only part of the line which is directly on the machines. These are carried through iron tubular conduits, as are all the rest of the circuits.

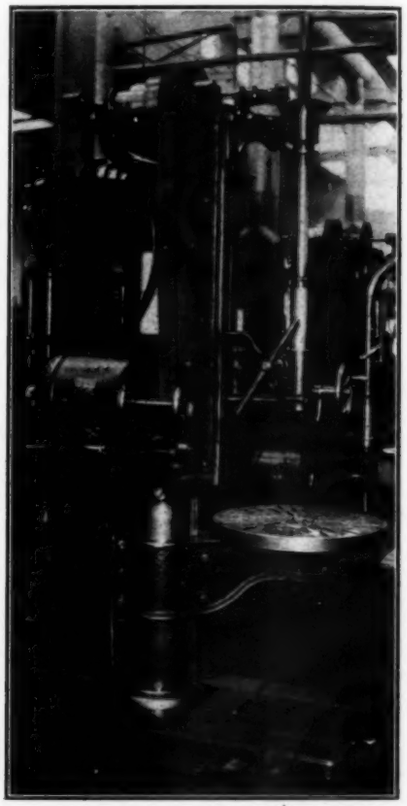


FIG. 3.—MOTOR MOUNTED ON DRILL PRESS.

Another question was that of arranging to secure by means of back gear on the lathes a double reduction which could be used to the greatest advantage. The method of solving the problem may be seen from the eighteen-inch lathe shown in Fig. 6. Here the cone was removed and replaced by a

quill, the motor driving direct to the quill through an intermediate shaft so as to get a double reduction, the intermediate shaft being supported from the base casting. In this case the back-gear ratio on the belt-driven machine, which was one to ten, was changed to one to six, using a motor with a one-to-six speed ratio. This gives a continuous one-to-thirty-six range of spindle speeds, which is wholly satisfactory for lathes of this size. Should a motor with only a one-to-three speed ratio be used on this lathe it may be seen that unless an additional gear change were provided there would be a gap of over 300 per cent between the range of spindle speeds obtained with the back gear in and those with the gear out. This wide variation of speed obtainable with the Reliance motor was one of the principal reasons for choosing this type of drive, although the simple method of control was in itself a considerable factor in determining the machine to be used.

In installing the motors it was necessary to wire the shop with new circuits and six lines with branches to the individual starters were laid beneath the wooden floor of the shop, metal tube conduits being used. A part of this conduit appears in Fig. 2. The central board for current supply is located in the wood-mill building, distributing lines running to four pan-

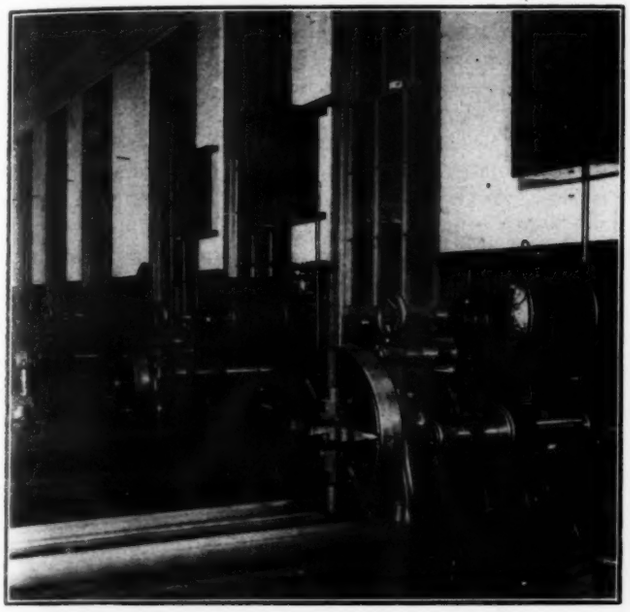


FIG. 4.—MOTOR-DRIVEN ENGINE LATHES.

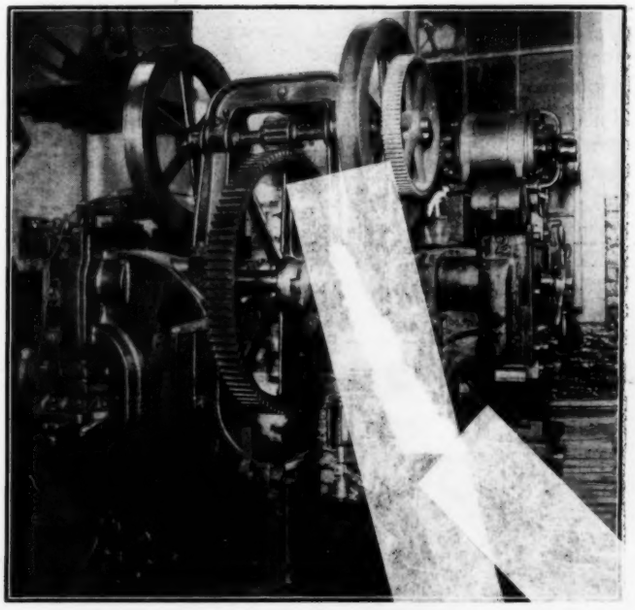


FIG. 5.—PUNCH AND SHEAR WITH MOTOR MOUNTED ON A

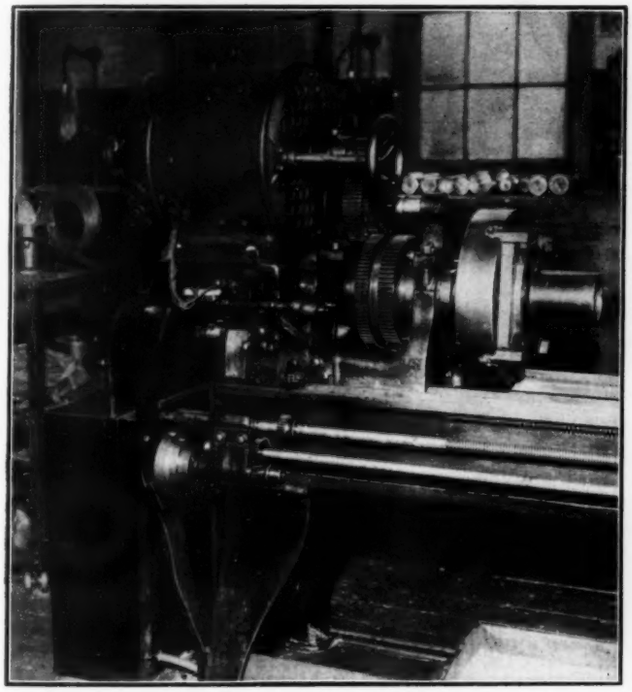


FIG. 6.—LATHE ARRANGED WITH STARTER ON FLOOR.

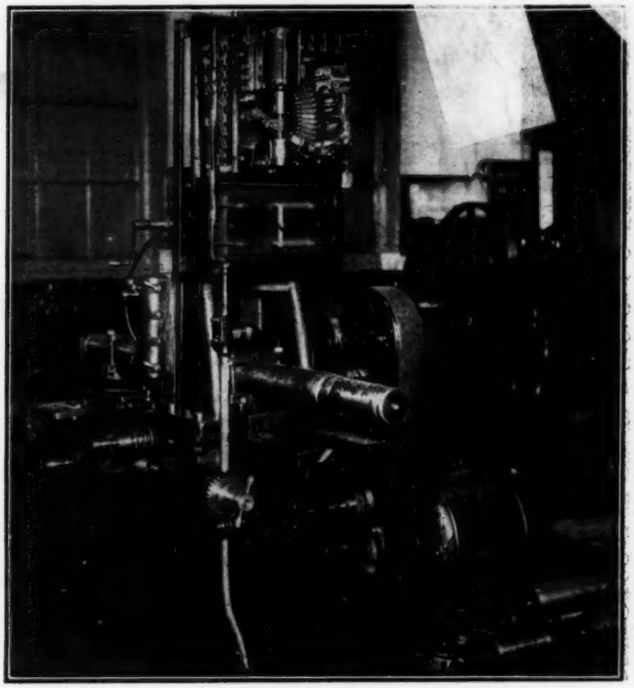


FIG. 7.—KEYSEAT MACHINE DRIVEN THROUGH BELT.

el boxes. Each of the other buildings is provided with a similar arrangement. Lead cables leading from the central board run in tile conduit under the shop floor, leading to the distribution panel boxes through the shops. Each panel box is provided with circuit breakers for the various machines on its circuit.

Inclosed arc lamps with clear globes are used for general illumination in all buildings with the exception of the fender and cabinet shops and machine shops in which mercury-vapor lamps have been installed. For bench work and in some positions local lighting is by clusters of incandescent lamps. The lighting is everywhere done both by day and by night and in connection with the better appearance and higher economy afforded by the individual drive makes this repair shop at once unique and efficient.

Motor Drive in a Furniture Factory.

One of the most complete and up-to-date manufacturing establishments in the Southwest using electric-motor drive is that of C. Mailander & Son, at Waco, Texas. This company, which makes high-grade interior fittings for banks, stores, offices and business establishments, is one of the largest in the state. The growth of the business has been rapid, and today its main building contains 50,000 square feet of floor space and is fitted with the latest improved labor-saving machinery. The main building is 100 by 175 feet, consisting of a basement and two stories of brick construction.

In the early days sufficient power was supplied by a single 7.5-horsepower motor, but as the load increased this was supplemented by a fifteen-horsepower gasoline engine, and a little later another 7.5-horsepower electric motor was added.

In selecting the source of power for the new plant steam was strongly considered, and the cost of the power plant, line shafting and belting were figured on the basis of using steam engine and line-shaft mechanical drives. Recognizing the advantages of the electric-motor drive, this system was also figured out very carefully. The economy and convenience to be gained by elimiting the long line shafts, loose pulleys and expensive belts, the lower maintenance expense and lower insurance rates, coupled with the securing of greater overhead room, led to the adoption of electric motors throughout.

The new plant is now equipped wtih nineteen motors, five of which are connected to the machines by means of flexible couplings, the others being connected by short belts. In Fig. 1 is shown a fifteen-horsepower induction motor, direct-connected to an eight-inch outside molder, and represents a typical direct-drive application.

In some cases the belted motors are placed beneath the floor, the belt going up to the machine through an opening in the floor and being protected by a wooden shield. This scheme affords maximum head room and freedom from belts on the working floor and at the same time gives maximum floor space. It also has the added advantage of getting the motor away from wood dust and shavings. Fig. 2 shows several motors mounted in the basement, the controlling apparatus being located right at the machines on the floor above.

Each motor is equipped with its own switch and controlling devices, conveniently located, so that the operator can start or stop the motor without moving from his position. Where the motors are open and subject to dust and shavings provision is made for blowing them out by means of compressed air, which keeps the coils and insulation clean, thereby preserving them and affording maximum opportunity for radiation.

These motors, all of which were supplied by the Western Electric Company, operate on a two-phase, sixty-cycle, 220-volt circuit, power being supplied by the local central station. All of the wiring is, of course, in conduit, and the installation from the standpoint of economy, convenience and low insurance rates is one of the best to be found in the Southwest.

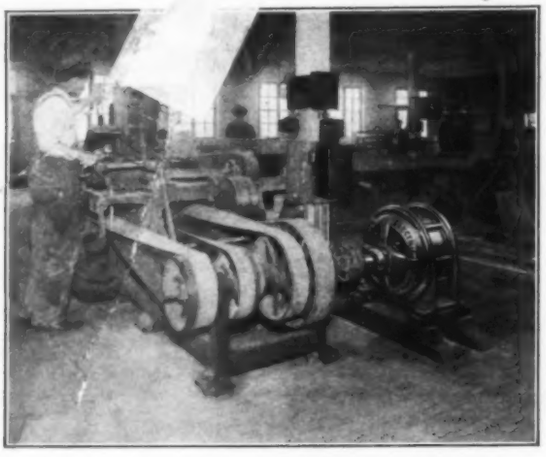


FIG. 1.—INDUCTION MOTOR DIRECT-CONNECTED TO MOLDER.

FIG. 2.—MOTORS IN BASEMENT DRIVING MACHINES ON FLOOR ABOVE.

Great Extension of Telephone Train Dispatching.

The extent to which the telephone has encroached on the telegraph as a means of dispatching trains on American railroads during 1910 is shown in a bulletin just issued at Washington, D. C., by the Interstate Commerce Commission.

An increase of 15,373 miles of railroad on which the telephone is used was shown during the year. On January 1, 1911, the telegraph was used on 175,211 miles and the telephone on 41,717 miles.

Another part of the bulletin gives data on the growth of the block-signal system on American roads.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

GENERAL ELECTRIC COMPANY.

The General Electric Company has issued its annual report for the year ended December 31, 1910. The income account compares with eleven months ended December 31, 1909, as follows:

	1910.	1909.
Total receipts	$74,707,689	$54,102,051
Expenses, interest, etc.	63,851,996	47,608,380
Net	*10,855,692	6,493,671
Dividends	5,214,368	5,214,352
Surplus	5,641,324	1,279,319
Previous surplus	17,381,381	16,102,062
Total surplus	23,022,706	17,381,381

*Equal to 16.65 per cent earned on $65,179,600 capital stock as compared with 9.96 per cent earned on same stock for eleven months ended Dec. 31, 1909.

General Electric Company's consolidated balance sheet as of December 31, 1910, compares with those of December 31, 1909, as follows:

ASSETS.

	1910.	1909.
Patents, franchises, etc.	$ 1	$ 1
Factory plan	15,516,314	14,330,958
Real estate	245,719	118,063
Stocks and bonds	23,666,833	22,329,664
Cash	14,912,400	17,623,467
Notes and accounts receivable	19,047,459	19,377,972
Due from allied companies	2,923,483	.....
Work in progress	589,788	462,223
Factory invoice	24,546,961	21,610,284
General and local inventories	3,249,315	3,321,871
Consignments	263,664	217,881
Copper mining investments	2,805,077	3,084,604
Total	107,767,017	102,440,989

LIABILITIES.

Capital stock	$65,179,600	$65,179,600
5 per cent debentures, 1892	40,000	40,000
5 per cent debentures, 1907	12,875,000	12,875,000
3½ per cent debentures, 1902	2,047,000	2,047,000
Accrued interest	83,664	83,664
Accrued taxes	173,405	.....
Accounts payable	2,796,230	2,753,617
Advance payments on contracts	245,819	777,133
Unclaimed dividends	.....	.....
Dividends payable	1,303,592	1,303,592
Profit and loss surplus	23,022,706	17,381,382
Total	107,767,017	102,440,989

The orders exceeded those received in the year ended January 31, 1907, the largest previous year, by 17.7 per cent, and were 105 per cent greater than for the year ending January 31, 1905. The yearly rate of orders was substantially uniform for each quarterly period, increasing slightly during the last quarter.

The total number of orders and contracts received during the year was 338,272—exceeding all previous records.

AMERICAN TELEPHONE.

The report of the American Telephone & Telegraph Company for the quarter ended March 31, 1911, compares as follows:

	1911.	1910.
Dividends	$5,095,218	$4,642,272
Interest and other revenue	2,524,238	2,813,438
Telegraph, traffic, net	1,325,846	1,321,156
Real estate	24,110	25,562
Other sources	141,881	86,922
Total	9,111,294	8,889,351
Expenses	842,497	781,703
Net	8,268,797	8,107,648
Interest	1,434,321	1,284,141
Balance	6,834,475	6,823,506

The American Telephone & Telegraph Company and associated holding and operating companies in the United States, not including connected independent or sub-license companies, report for the two months ended February 28, 1911, as follows:

	1911.	1910.
Gross	$28,311,089	$26,039,253
Operating expenses, taxes	11,196,759	9,664,161
Balance	17,114,330	16,375,092
Maintenance and depreciation	8,853,106	8,197,176
Net	8,261,224	8,177,916

In the above all duplications, including interests, dividends and other payments to American Telephone Company by associated holding and operating companies, are excluded.

CHICAGO CITY RAILWAY COMPANY.

The Chicago City Railway Company has issued a report covering the joint account with the city of Chicago for the year ended January 31, 1911. The income account, which this year includes the Southern Street Railway Company, compares with the previous year as follows:

	1911	1910
Passenger revenue	$9,762,275	$8,735,704
Other revenue	343,169	358,343
Total revenue	10,105,444	9,094,047
Op. exp., tax., renewals and int. on inv.	8,358,325	8,230,734
Net income	1,747,119	863,313
City's prop., 55%	960,915	474,822
Co.'s prop., 45%	786,203	388,490

The consolidated balance sheet of the Chicago City Railway and Southern Street Railway Company as of January 31, 1911, shows assets as follows: Chicago City Railway Company traction valuation, June 30, 1906, $21,000,000; certificates issued $20,000,243; Southern Street Railway Company traction valuation, August 1, 1908, $775,000; certificates issued $741,208; cash, $2,421,133; accounts and notes receivable, $1,032,407; accounts paid in advance, $36,018; total, $46,006,011. Liabilities: Investment, representing purchase price of properties, in accordance with terms of city ordinance, $42,516,452; accounts payable, $898,843; city of Chicago's proportion of profits, $960,075; companies' proportion $786,203; reserve for damages, $675,791; reserve for renewals and depreciation, $168,645; total $46,006,011.

AMERICAN DISTRICT TELEGRAPH.

The American District Telegraph Company of New Jersey has issued its report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
Earnings	$3,894,578	$3,638,928
Expenses	3,090,832	2,756,779
Profits	803,746	882,149
Dividends	398,549	398,496
Surplus	405,197	483,653
Previous surplus	2,116,390	1,632,737
Profit and loss adjust., dr.	40,160	.....
Profit and loss surplus	2,481,427	2,116,390

NEW ORLEANS RAILWAY & LIGHT COMPANY.

The annual report of the New Orleans Railway & Light Company shows a balance sheet as follows for the year ending December 31, 1910:

ASSETS.

Fixed Capital—Property, plant, franchises, etc.		$64,732,279.51
Investments—Securities owned (cost value)		44,699.75
Re-acquired Securities — New Orleans Railway & Light Co. stocks (par value)		6,000.00
Floating Capital—		
Material and supplies	$300,203.61	
Cash in banks and office	385,429.63	
Bills receivable	393,942.95	
Accounts receivable	410,229.59	
Interest receivable	265.83	
		1,490,071.61
Special Deposits—Coupon, dividend, sinking fund, etc.		397,340.14
Prepayments—Insurance Rents, etc.		39,791.28
Suspense Accounts—Discount and expenses on 4½% and 5% bonds sold	$1,042,774.51	
Other items in suspense	28,109.04	
		1,070,833.55
		$67,781,065.84

LIABILITIES.

Capital Stock—		
Preferred		$10,000,000.00
Common		20,000,000.00
		$30,000,000.00
Stocks of Subsidiary Companies held by others—		
Preferred	$ 38,800.00	
Common	182,000.00	
		220,800.00
Funded Debt—		
New Orleans Railway & Light Co.:		
General mortgage 4½% bonds:		
Authorized issue	$30,000,000.00	
Held in reserve by trustees	12,330,000.00	
Amount issued	$17,670,000.00	
Held by trustee of 5% bonds	126,000.00	
Amount outstanding	$17,544,000.00	
Refunding and General Lien, 5% Gold Mortgage Bonds: (Authorized issue, $50,000,000.)		
Amount issued	$ 3,168,000.00	
Held in treasury	587,000.00	
	$ 2,581,000.00	
	$20,125,000.00	
Funded debt of subsidiary companies	12,324,500.00	
		32,449,500.00
Unfunded Debt—		
Bills Payable	$ 25,000.00	
Accounts payable	518,623.06	
Franchise tax — accrued, not due	6,287.28	
Dividends declared and unpaid	262,733.27	
Interest—due and accrued	864,596.34	
		1,677,239.95
Deferred liabilities—Items in suspense		13,704.83
Reserves for bad debts, accident liability, etc.	$ 130,937.34	
Reserve for depreciation	1,004,390.24	
		1,135,327.58
Surplus—		
New Orleans Railway & Light Co. interest	$ 2,267,469.35	
Minority stockholders' interests	17,024,13	
		2,284,493.48
		$67,781,065.84

NORFOLK & PORTSMOUTH TRACTION.

The Norfolk & Portsmouth Traction Company reports for eight months ending February 28, 1911, compared as follows:

	1911.	1910.
Gross earnings	$1,400,079	$1,284,256
Operating expenses	788,008	725,121
Net earnings	612,071	559,135
Taxes, interest, etc.	500,918	513,140
Surplus	111,152	45,994

New Electrical and Mechanical Apparatus and Appliances.

A New Type of Synchroscope.

Infallibility is an essential characteristic of a synchronism indicator, otherwise its indications will sooner or later result in serious disaster. Lamps, when used for this purpose are infallible as regards equality of frequency, but they only give the merest notion of the difference in phase. For instance, a variation of sixteen degrees in phase difference corresponds to a change in voltage across the lamp of only one per cent, and therefore a slight error in judgmet may result in a considerable shock when the switch is thrown in. Furthermore, the lamp does not indicate whether the incoming machine is fast or slow and much time is lost in wrong manipulation of the speed.

The rotating synchroscope which operates as a miniature induction motor was devised to facilitate rapid synchronization by indicating which machine is fast or slow and also the phase displacement between the machines. They are almost invariably used with synchronizing lamps so as to avoid any great disaster. This expedient is not very satisfactory, as it requires the attendant to divide his attention between two different objects.

FIG. 1.—SYNCHROSCOPE.

The Weston Electrical Instrument Company has recently brought out a new type of synchroscope, shown in Fig. 1, which has all the advantages of the ideal rotating synchroscope and yet is absolutely infallible.

This novel instrument consists of a phase meter combined with a synchronizing lamp so placed that the light from the lamp inside the case is connected upon a translucent glass scale (see Fig. 2). The phase meter is a Weston electrodynamometer similar in construction to the Weston single-phase wattmeter described in our issue of April 8.

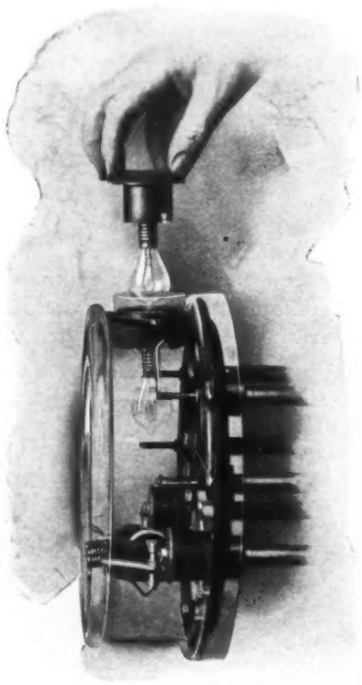


FIG. 2.—PHANTOM VIEW, SHOWING RELATIVE POSITIONS OF LAMP, POINTER AND SCALE.

The fixed coil of the electrodynamometer is connected in series with a slightly inductive resistor across the line, while the moving coil is connected in series with a condenser across the incoming machine, as shown in Fig. 5.

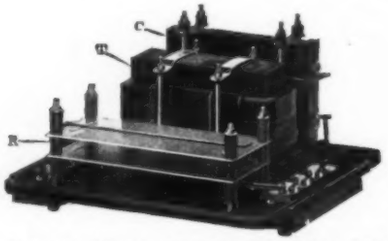


FIG. 3.—INTERIOR OF BOX, SHOWING CONDENSER, TRANSFORMER AND RESISTOR.

The constants of these two circuits are so chosen that when the machines are in perfect syenhronism the currents in the fixed and moving coils are in exact quadrature, and, therefore, no torque is produced and the pointer remains at rest in the middle of the scale. Since the lamp inside the case is connected to synchronize light, the shadow of the pointer is seen in the middle of the scale only when the machines are in synchronism.

If there is a difference in frequency between the machines to be synchronized, the phase displacement will vary continuously from coincidence to opposition, back to coincidence, and, so on, causing the pointer to swing back and forth across the scale. The period of these swings coincides exactly with that of light or darkness; therefore, the pointer is visible only during every other swing and appears to rotate continuously in one direction. The direction of rotation indicates whether the machine is fast or slow, and the speed of rotation is a measure of the amount by which the frequency differs from normal.

Referring to Fig. 6, the electromotive-force waves of two machines which differ in frequency are drawn in at the top of the diagram; these also represent the electromotive forces which combine in producing the current through the lamp, the resultant current being drawn in dotted lines. The shaded band represents the limits within which the resultant current is not sufficient to light the lamp; therefore, the lamp glows only during those periods when the resultant maximum falls outside the shaded band. The periods of light and darkness corresponding to this condition are shown plainly underneath the curves.

FIG. 4.—AUXILIARY BOX.

The second set of curves corresponds to the upper set, except that the first wave is assumed to belong to the incom-

ing machine, and is, therefore, shifted one-quarter period ahead due to the condenser in the circuit. These currents are those active in the coils and the torque is equal to the instantaneous product of these currents, as shown by the curves bounding the shaded areas.

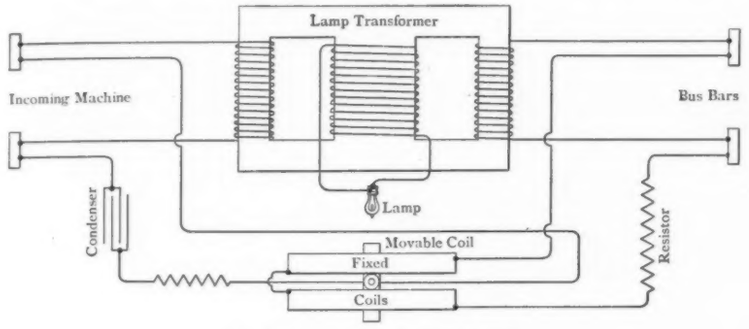


FIG. 5.—DIAGRAM OF CIRCUITS.

An inspection of these curves shows that the torque periodically reverses and reaches alternately a positive and negative maximum with the transition from light to darkness and vice versa.

The lowest set of curves shows the same curves, except that the slow wave is assumed as that of the incoming machine and is, therefore, the one to be shifted ahead by the condenser.

Of course, these are exaggerated cases chosen simply to illustrate a principle and show why the direction of apparent rotation shows which machine is fast or slow. In actual practice such a large difference in frequency would cause the lamp to flicker rapidly and the pointer would flutter near the middle of the scale, being unable to follow such rapid alternations of torque. If it were attempted to show waves of slight difference in phase it would require large folding plates to contain waves enough to cover the period of one complete cycle of light and darkness.

When equality of frequencies is attained, rotation ceases and the pointer comes instantly to rest; its position on the scale denoting the amount of phase displacement between the machines to be synchronized. The deflection for unit phase-difference is large and fairly uniform, except at synchronism, where it is very large. At normal frequency and voltage five degrees of phase displacement from synchronism will produce a deflection of 0.5 inch.

The condenser, the lamp transformer and the resistor are all mounted in one box, Fig. 4, an interior view of which is shown in Fig. 3.

There are no parts of the instrument which are connected directly to the main circuits, and, therefore, when transformers are used all secondary circuits can be grounded.

The accuracy of this instrument under widely varying conditions of frequency and voltage is quite remarkable. For instance, a sixty-cycle, 110-volt Weston synchroscope under actual test indicated true synchronism and the phase difference within one degree at frequencies from 40 to 80 cycles per second and at voltages from 95 to 130 volts.

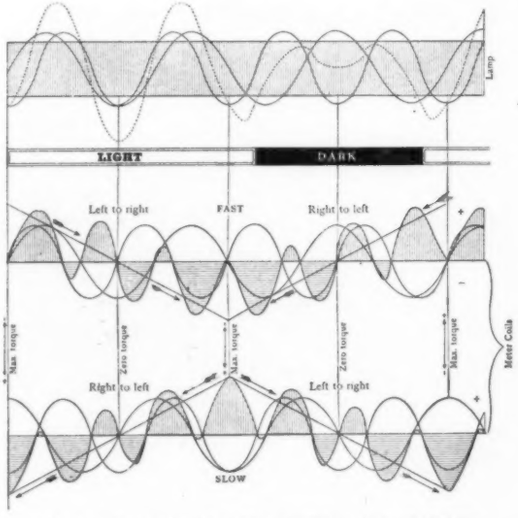


FIG. 6.—DIAGRAM OF CURRENTS AND TORQUE.

"A-W" Mazda Regulator.

The fact that the resistance of the Mazda lamp filament increases with increased temperature has made possible the construction of an extremely simple form of voltage regulator for use with series lamps. This is known as the "A-W" Mazda Regulator

On series circuits, using Mazda lamps, when lamps burn out and are short-circuited by their film cut outs, the increase in resistance in the remaining lamps prevents to a large extent an abnormal rise of current. That this is not the case with carbon lamps is shown by the curves given below. Curve 1 represents carbon lamps without regulator; curve 2 shows current rise with constant resistance; curve 3 shows Mazda lamps without regulator; curve 4 shows the normal operation of the lamps governed by the "A-W" series regulator. The horizontal figures show per cents of lamps short-circuited, and the vertical figures the rise of current in the remaining lamps.

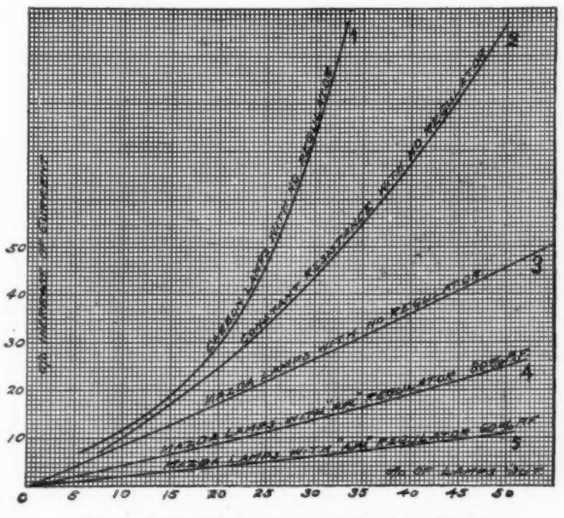


FIG. 1.—CURVES OF A-W MAZDA REGULATOR.

For example, suppose that after a severe storm 30 per cent of the lamps had burned out and become short-circuited. With carbon lamps and no regulator, the rise of current in the re-

maining lamps would have been 73 per cent, resulting in their immediate destruction. Had the resistance been constant (curve 2), the rise would have been 43 per cent, and with Mazda lamps and no regulator (curve 3), it would have been cut down to 25 per cent.

This regulator will keep the current practically constant for all ordinary conditions. Under abnormal conditions as illustrated above, it will still limit the current to a perfectly safe amount.

Provision is also made to reduce the current to normal value, if desired, while the large percentage of lamps is still out. In other words the regulator is automatic and requires no attention.

FIG. 2.—REAR VIEW OF SWITCHBOARD.

However if a change in current is desired, it can easily be accomplished.

The "A-W" series regulator is essentially an inductance in series with the lamps, working in the secondary circuit of a transformer having several taps for the accommodation of partial load conditions. The inductance is also tapped at various points, and these taps are brought to a gang-plug switch, making it very convenient to use any desired point.

The switchboard is conveniently arranged with an ammeter operated by a series transformer. The two stab switches, properly fused, located below the ammeter, control the primary circuit leading to the transformer.

The construction of the switchboard is very substantial, being made up of heavy wrought-iron pipe with proper fittings. The face of the switchboard is 18 inches by 48 inches, 1.5 inches thick, beveled and polished blue Vermont marble. This switchboard enables this system to be handled in its most convenient manner, and is a component part of the outfit.

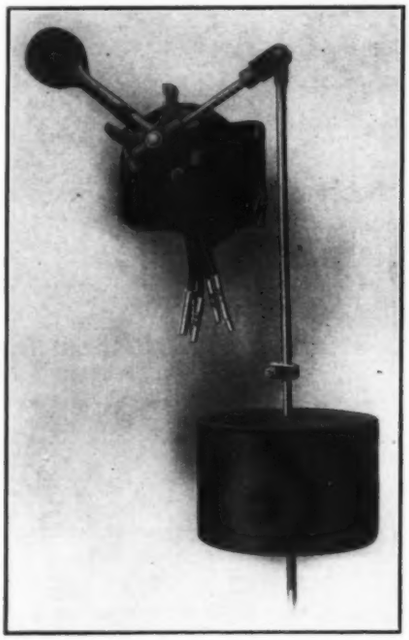


FIG. 1.—AUTOMATIC FLOAT-SWITCH.

The system has no moving parts, has a high efficiency and power-factor, with a normal power-factor at partial load, and due to its simplicity of construction, has an exceptionally long life.

This device has been brought out by the Packard Electric Company, Warren, O.

An Automatic Float-Switch.

An automatic float-switch of new design has recently been placed upon the market by the Westinghouse Electric & Manufacturing Company. The new design embodies several features that recommend it highly for the control of motors driving pumps that empty into reservoirs, or drain pumps, sewers, etc. The operation of the switch is entirely automatic and the mechanism requires no attenion beyond an occasional inspection and oiling. The switch is operated by a cylindrical steel float which plays between brass stops on a vertical rod, as shown in Fig. 1; the stops are adjusted to the upper and lower water levels. When the float presses against either stop, a U-shaped tripping lever attached to the float-rod engages a pivoted weight-arm and carries it upward and around past the vertical position. The weight-arm then falls, engages an arm on the switch-drum shaft, and snaps the switch open or closed according to the direction in which the weight-arm is thrown. A buffer receives the force of the weight-arm's fall. When the float-rod is attached to the tripping lever, as shown in Fig. 1, the pump will be started when the float presses on the lower stop and hence is properly arranged for filling reservoirs. With the rod attached to the other side of the lever, the switch is adjusted for drainage purposes, as the motor will be started when the float presses against the upper stop. The switch is of the drum type and, as may be seen, is provided with renewable contacts and fingers.

The float and float-rod are heavily galvanized and are enameled and baked. This finish effectually prevents rust. The standard float-rod permits maximum variations in levels of six feet.

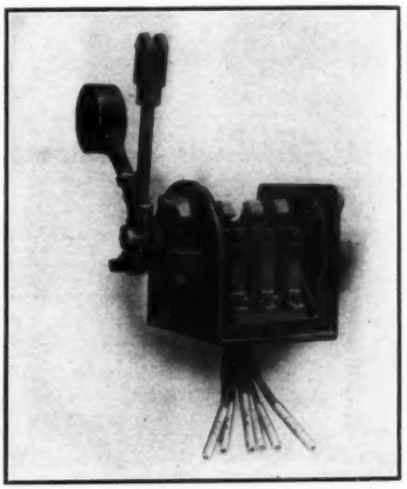


FIG. 2.—INTERIOR OF SWITCH.

These switches are made in two styles—double-pole for direct-current and single-phase alternating-current motors, and three-pole for polyphase motors. The maximum capacity is 50 amperes at 550 volts. The motor is connected directly across the line and hence can be used only with motors that do not require reduced starting voltage.

A New Line of Direct-Current Interpole Generators.

The increasing use of electric power demands overload capacities in direct-current generators, together with sparkless commutation and the highest degree of mechanical excellence. The new standard line of Westinghouse Type Q interpole direct-current generators thoroughly fulfills these requirements and furnishes a most desirable engine-driven generator for direct-current two-wire or three-wire service.

Prominent characteristics of Type Q generators are interpole construction, thorough ventilation and ruggedness with relatively light weight.

The interpole construction provides perfect commutation, with a definite brush position covering all ranges of load. Heavy overloads may be imposed without sparking or flashing and wear on commutators and brushes is reduced to a minimum.

The ventilation of all current-carrying parts and of the armature cores of Type Q machines is such that there can be no hot spots at points dangerous to the insulation.

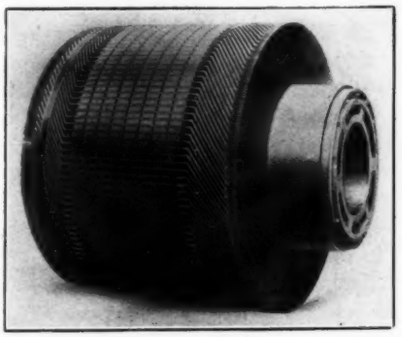
The frames are of cast steel, a material of high magnetic permeability, which furnishes ample strength with economy of both weight and space, contributing to good ventilation, low freight charges and easy handling.

The rotors or armatures of Type Q generators are designed for direct mounting on the shaft of the prime mover, which may be of any type of suitable speed.

The stators or fields are arranged for mounting on masonry foundations or directly on the bedplate of the prime mover.

Ventilation has received particular attention in the design of these machines. The design of all the windings is such as to give shallow coils with the result that the heat in any part has but a very short distance to travel to the surface from which it is radiated. This, with a very complete and thorough system of air circulation, insures an entire absence of hot spots and a uniformity of temperature never before obtained in similar machines. These features enable these generators to stand heavy overloads without injury.

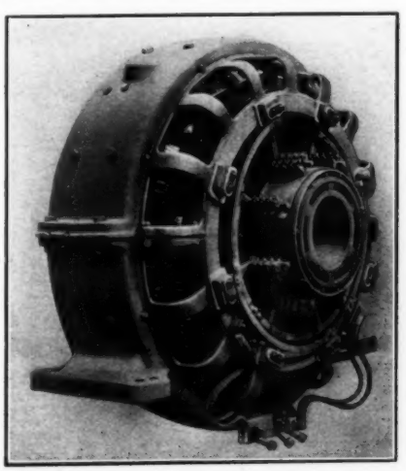
Type Q generators are standardized for desirable and usual ratings from 25 to 1,000 kilowatts, with speeds conforming to the best engine practice. Up to 100 kilowatts in capacity the standard voltages are 125 or 250. From 100 to 300 kilowatts these machines are wound for 125, 250 or 600 volts, and from 300 to 1,000 kilowatts they are wound for 250 and 600 volts. Machines of 250-volt rating are regularly equipped for three-wire operation.



ARMATURE OF INTERPOLE GENERATOR.

Most electrical troubles in a direct-current generator arise from faulty commutation, especially during overloads. They begin with sparking, which burns away the copper and brush, causing high mica, roughness of surface, flashing, breakdowns in insulation and deterioration in brushes, brush holders and commutators.

In Type Q generators the proper conditions for commutation are obtained by the use of small poles, interspaced between the main poles.



NEW DIRECT-CURRENT INTERPOLE GENERATOR.

The interpoles have their windings in series with the armature and set up a magnetic field which annuls the effect of the field formed by armature magnetization and generates in the commutated coil an electromotive force which assists the reversal of the current. Since the interpole coils are in series with the armature, the interpole field strength varies in proportion to the load and it thus has the proper corrective effect at all loads.

Since the electromotive force due to the interpole, which assists reversal, has a definite position under the interpole, the coil being reversed must be located accurately with respect to this reversing electromotive force. Therefore, the correct position of the brushes must be determined accurately before the generator is put in service. When this point has been properly located, shifting the brush position is not only unnecessary but detrimental.

Grounding Secondaries.

The Underwriter's National Electric Association has recommended the grounding of secondary circuits up to 150 volts. This action was taken after consultation with and under the advice of leading construction engineers.

Many electric light companies now ground their secondaries either to water mains or to home-made grounding devices. Other companies have put the matter off because they have been prohibited from using underground water mains or have been unable to secure reliable grounds at a reasonable cost. The best ground is a connection to a water system. In some cities, however, this is prohibited because of the fear of electrolysis. Whenever a transformer breaks down or a circuit is crossed there is only a momentary flow of current to the ground until the fuse or the circuit-breaker opens up. This momentary flow is alternating in character and has therefore no electrolytic effect. The water main can therefore be safely used and is recommended whenever it is practical to make the ground connection without undue expense. Wherever water mains are not available, or where a portion of the street, side-walk or basement must be torn up in order to get to water connection, some other method of grounding must be used.

The old-time method of burying a copper plate, a lot of junk copper or a coil of copper wire has been found to be unreliable and at best expensive.

Iron pipes or rods driven into the soil are good as long as they last and the surrounding earth is kept moist. Moist earth is a prime essential. The pipe or rod driven into dry soil is valuless because dry soil is an insulator

and an extremely high resistance of ground is the result. Moist earth is sometimes obtained by surrounding the pipe with salt or salt water. The presence of salt, however, increases corrosion and in a short time the iron has rusted out, leaving a useless ground connection. They are, therefore, unreliable.

It is evident from the above that pipes, rods or copper plates cannot seriously be considered when grounding so extensively as for transformer secondaries. A low-cost, permanent ground of fairly constant resistance and of as long a life in the soil as the transformer itself, is absolutely essential. To meet this need Paragon ground cones were placed on the market, and W. J. Canada, electrical engineer for the Rocky Mountain Fire Underwriter's Association, recommends their use wherever water mains are not available.

The Paragon ground cones, made by Paragon Sellers Company, 152 North Fifth Avenue, Chicago, Ill., consist of a cone of perforated copper, filled with charcoal. A hollow braided cable, into which the ground wire is to be run and soldered, is an integral part of the cone. Their first cost is low and they are easily installed. No salt is required; the charcoal is hygroscopic and effectually takes its place. They are made in two sizes, and are so packed that they can easily be distributed along a line like cross-arms, and installed by the work-gang later.

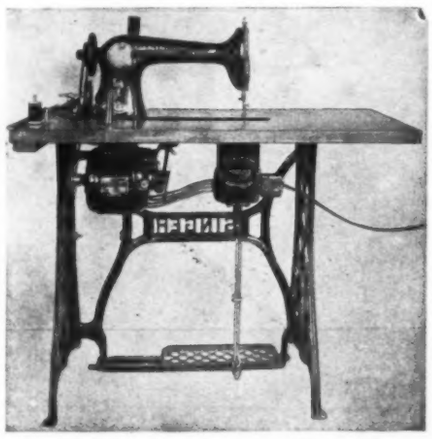
Treadle-Operated Controllers.

There are many applications of the small motor where treadle control is of great convenience and advantage, small motor-driven lathes, saws, sewing machines, etc., being examples. By simply varying the pressure on the foot treadle, all desired speeds of the motor can be obtained without use of the hands.

The new type of Cutler-Hammer treadle controllers are made in six sizes from 0.1 to 0.25 horsepower, 115 and 230 volts, for use with direct-current series, shunt or compound motors. This type of controller is for installation under the table or machine board, the controller shaft being connected to the toe of an ordinary machine foot treadle by means of a rod. To start the motor the shaft is pulled down by pressing on the toe of treadle. This causes a rugged steel contact disk to bridge the two lower steel contact posts. A greater pressure moves the sliding arm over the contacts and increases the speed as desired, four separate speeds being provided. When pressure is released from the treadle the arm and disk return to the "off" position, opening the circuit. When quick stopping is desired, pressure is applied to the heel of the treadle, forcing the sliding arm to the upper contacts and giving a strong dynamic braking.

TREADLE-OPERATED CONTROLLER.

The disk and contact posts being steel, become magnetized by the coils in the rear of the controller and are thereby held in firm contact when the motor is running and in stopping the tendency is to remain in this position against the tension of a small spring mounted below the disk. When the upward motion of the controller shaft causes the tension of the spring to overcome the magnetism, the disk leaves the contact posts with a sharp snap, breaking the circuit quickly and preventing arcing.



CONTROLLER APPLIED TO SEWING MACHINE.

The Cutler-Hammer treadle controller has been approved by the National Board of Fire Underwriters and is ruggedly designed to withstand the usage encountered in manufacturing establishments. A cast iron casing 6.5 inches high by 4.5 inches deep incloses all parts.

An Electrical Fire-Damp Detector for Mines.

The principle upon which the fire-damp detector is based is the well-known catalytic property of platinum, or, in other words, on the fact that platinum and some other substances increase in temperature in the presence of hydrogen. Methane or fire-damp contains a large proportion of hydrogen, the chemical formula being CH_4. It is a very light gas, and highly explosive when mixed with air in certain proportions, and is present to a greater or less extent in nearly all coal mines.

The detector consists of two springs, each fixed rigidly at one end, while the free ends overlap slightly. Each spring is composed of two pieces of dissimilar metal, steel and brass for example, having different coefficients of expansion. On heating such a spring, it bends or curves, due to the greater expansion of the brass.

Below these springs are disposed coils of fine wire, which are heated by a current flowing through them, in series with a glow lamp of suitable candlepower. One coil is of pure platinum and the other of some metal which has no catalytic property.

The platinum is maintained constantly at a temperature which may be a very dull red or thereabout, the reason for which is that in a heated state, platinum is more sensitive to catalytic action.

Under normal conditions, both springs curve upward equally, and do not make contact with one another. Any variation of atmospheric temperature affects both equally, also any variation, within limits, of the line voltage and consequent variations of current.

If, however, fire-damp be present in the air, the platinum coil will increase in temperature and thereby cause the spring above it to curve upwards to a sufficient extent to come in contact with the other spring. Contact between these springs establishes a circuit through a small solenoid magnet, which, on being

energized, actuates indicating or cut-out gear.

The detector is sufficiently sensitive to operate with two per cent of firedamp, but may be set for any greater percentage desired. It is suitable for use on direct-current or alternating-current circuits, and as the box containing it is only about 12 by 3 by 3 inches it takes up very little space and is adapted thereby to be fixed near the roof where the gas, owing to its lightness, will invariably collect.

The detector box is provided with openings covered with fine mesh gauze, as in a safety lamp, to admit the surrounding air, without being capable of transmitting flame.

New Internal-Combustion Engine.

A new type of internal-combustion engine is now being placed on the market by the Dome Valve Gas Engine Company. The distinguishing feature of this design is that the valves, instead of being of the usual mushroom pattern, are made in the form of a pair of large hollow domes, which concentrically surround the outside of the cylinder head, and are inclosed in an oil-containing cover. The gas inlet and exhaust ports are disposed laterally in a domed cover, which, bolted to a circular flange on the upper end of the cylinder, encases the outside surface of the cylinder head and the interposed dome valves, acting as a "helmet."

The valves of the engine reciprocate within the annular space between the outer surface of the cylinder head and the inner surface of their cover, and they have horizontal parts situated laterally. The cylinder head is also provided with similar horizontal ports for inlet and exhaust, above and below these ports being a series of metal packing rings, over which the inner dome valve slides for a short distance, the outer cut-off dome valve sliding in turn over it. The valves are positively driven through a pair of slide rods by a small crankshaft and short connecting rods, making one-half the revolutions of the main crankshaft. This small crankshaft is turned by the main crankshaft by gearing. The dome valve tops are pierced with orifices, and a small quantity of oil is maintained at a constant level in the annular spaces above and below the cylinder ports. At every downstroke of the valves a proportioned quantity of lubricant is automatically distributed all over the working surfaces, consequently valve lubrication is independent of the oil in the crank chamber.

The inner dome valve slides downwards for its ports to pass over the widest of the packing rings, making a gas-tight, oil-sealed and balanced joint for compression and explosion, ascending for exhaust and admission in cooperation with the outer dome valve. Both the valves are in mechanical balance, and the gas pressure is held by the inner dome valve solely, no strain being borne by the valve cover. It is claimed that the engine is entirely free from over-heating and warping troubles, because of the relatively small area exposed to the gas, the dome valves being external to the cylinder head.

Davenport Electric Show.

In conjunction with the conventions of the Iowa Electrical Association and the Iowa Street and Interurban Railway Association in Davenport, April 19 to 22, there was held in the Coliseum Building an electrical show under the joint auspices of the manufacturers of these two associations, which will be considered the most comprehensive exhibition ever conducted at a state convention.

The show was open to the general public every afternoon and evening, and was conducted in a manner similar to the shows held annually in the large cities. A musical program was provided each day, and the interest manifested by the citizens of Davenport reflects credit on those having this affair in charge.

The following is a partial list of the exhibitors with brief descriptions of the exhibits maintained:

Julius Andrae & Sons Company, Milwaukee, Wis., exhibited American heating and cooking appliances and Quam vacuum cleaners and accessories. The company was represented by Otto Borchet.

Allis-Chalmers Company, Milwaukee, Wis., maintained a very elaborate exhibit which occupied the entire stage at the north end of the hall. The principal feature of the exhibit was an actual model of an Allis-Chalmers steam turbine. This occupied the center of the exhibit space and was surrounded by exhibits of alternating and direct-current motors; four different sizes of transformers; fifty-horsepower interpole railway motors; type "S 4" railway controllers; air valves; portable air compressors; and centrifugal pumps. There were also shown on portable stands numerous photographs of the company's materials and views of the shops at Milwaukee. J. F. Gardner, S. C. Orrell, Ervin Dryer, W. M. S. Miller, were in attendance with Fred S. Sly in charge of the exhibit.

American Car Company, St. Louis, Mo., exhibited a completely equipped Brill type "E" truck for electric cars. The company was represented by Fred W. Brill.

American Steel & Wire Company, Chicago, Ill., occupied two booths which were arranged as reception quarters for the delegates. B. H. Ryder was in attendance.

Bryan-Marsh Company, Chicago, Ill., exhibited a complete line of wire-type Mazda lamps of all sizes. The company was represented by Sam Furst.

Central Electric Company, Chicago, Ill., showed a complete line of heating appliances, Fort Wayne, Westinghouse and Duncan meters, Benjamin specialties, General Electric and Westinghouse alternating and direct-current fans, Columbia lamps and a line of small supplies. The company was represented by S. B. Switzer and B. J. Kacin.

General Electric Company, Schenectady, N. Y., exhibited a complete line of chafing dishes, percolators, toasters, sad irons, stoves, luminous radiators, soldering irons, sealing-wax heaters, motors, glue pots, induction and direct-current meters, direct and alternating-current fans of all sizes, small motors from one-thirtieth to two horsepower, transformers, and electric drills. The company was represented by W. Kahl, W. H. Coleman, J. Osborne, W. T. Dean, G. Seabury, R. Swain, J. Buchanan, J. D. A. Cross, J. VanSplutter, C. Dorticos, Charles Ives, C. Matteson, J. Ashby, T. Fletcher, S. Paine, C. R. Hunt and C. T. Reiss.

Cooper Heater Company, Chicago, Ill., exhibited a line of pressed-steel hot-water car heaters. The company was represented by W. L. Blackwell.

Duncan Electric Manufacturing Company, Lafayette, Ind., exhibited a complete line of alternating and direct-current meters and switchboard instruments. The company was represented by Adrien Tobias and J. A. Clark.

Electric Appliance Company, Chicago, Ill., exhibited A-W Mazda street-lighting outfits, Sangamo meters, Packard transformers, Emerson fans, American Electric heating appliances, Crouse-Hinds conduletes and panel boards, Thor electric washing machines and Benjamin tungsten arcs. The company was represented by F. J. Alderson, W. F. Parker, C. F. Alline, J. K. Alline and O. Brasher of the Sangamo Electric Company.

Electric Service Supplies Company, Chicago, Ill., exhibited models of pay-as-you-enter and pay-within cars, luminous-arc head-lights, Garton-Daniels lightning arresters, Keystone pneumatic bell-ringers, trolley catchers and miscellaneous supplies. Thomas H. Henkle and C. C. Ewing were in attendance.

Emeis Manufacturing Company, Davenport, Iowa, exhibited a complete line of Emeis magnetos for automobiles, automobile searchlights and various other fittings. H. E. Emeis was in attendance.

Evans, Almirall & Company, Chicago, Ill., maintained reception quarters and distributed literature relative to steam heating and power-plant piping. F. Stevens was in attendance.

Fort Wayne Electric Works, Fort Wayne, Ind., exhibited watt-hour meters, bell-ringing transformers, small motors, lighting transformers, series alternating regulators, switchboard panels, alternating and direct-current fan motors and various instruments. The company was represented by A. L. Pond, A. P. Dunn and Charles Resch.

Franks Manufacturing Company, Rock Island, Ill., made a comprehensive exhibit of the only adjustable incandescent-lamp fixtures at the show. These included floor standards, wall fixtures, ceiling fixtures, etc., all with the patented adjustable feature which allows the lamp to be placed

in any position. W. L. Franks was in charge of this exhibit.

W. R. Garton Company, Chicago, Ill., exhibited the Electric Railway Equipment Company's overhead material, Stackpole carbon brushes, Waterbury wires and cables, Bliss tool-steel gear and pinion teeth, Heany fireproof wire and the Lord Manufacturing Company's retrievers, lightning arresters, etc. E. Lewis was in attendance.

Thomas G. Grier Company, Chicago, Ill., exhibited a complete line of Condit Electrical Manufacturing Company's circuit-breakers and oil switches. J. E. Erickson was in charge of this exhibit.

Holophane Company, Newark, Ohio, maintained a very elaborate exhibit showing a complete line of Holophane reflectors of both glass and steel types and a complete assortment of various other glassware. The company was represented by Morgan P. Ellis and E. B. Gray.

Illinois Electric Company, Chicago, Ill., exhibited a complete line of Klein's tools, American, Star brand, weather-proof wire, Pierce specialties, American heating and cooking devices, Orangeburg fiber conduit, Bryan-Marsh Mazda lamps and Westinghouse and Duncan meters. The company was represented by J. A. Duncan and H. H. Morehouse.

Interstate Electric Company, Sioux City, Iowa, maintained reception quarters in the Coliseum and in a tent on the outside of the building maintained a working exhibit of a crude-oil engine. The company was represented by G. S. Chase and Arthur Ruebel.

Iowa Electrical Machinery Company, Waterloo, Iowa, exhibited tungsten arc lamps, incandescent street-lighting fixtures, pot-heads and service terminals, fuse boxes, and the new Pemco series sockets. The exhibit was in charge of Ray H. Manwaring.

H. W. Johns-Manville Company, Plainville, Conn., exhibited Linolites, friction tape, batteries, rubber conduit, Noark fuses, fuse blocks, molded mica sockets, asbestos wood and a complete line of packing, roofing and pipe coverings. The company was represented by W. B. Roberts and O. S. Coykendall.

Midland Fixture Company, Davenport, Iowa, exhibited a complete line of electroliers, floor standards, wall brackets, and glassware. The company was represented by J. Tomquist.

Minerallac Electric Company, Chicago, Ill., exhibited the Chicago printing meters which were attached to meters on the city circuit and were shown in operation. The company was represented by C. Lovejoy and H. Sines.

Monarch Electric & Wire Company, Chicago, Ill., showed samples of Monarch weather-proof wire, a line of Hunter and Tuerk alternating and direct-current fans and a complete line of construction material. H. E. Mason was in attendance.

Perfection Vacuum Cleaner Company, Chicago, Ill., exhibited stationary and portable vacuum cleaning plants which were shown in operation.

Simplex Electric Heating Company, and **Simplex Electrical Company,** Chicago, Ill., showed a complete line of heating and cooking devices comprising electric toasters, sad irons, milk warmers, travelers' stoves, heating pads, cereal cookers, and combination sets including tea pots, chafing dishes and percolators, with one interchangeable base containing the heating element, this base being also used as a disk stove. There were also shown samples of lead-covered steel-tape cable. William F. Hruby was in attendance.

Sterling Electric Company, Warren, Ohio, exhibited in the booth of the Iowa Electrical & Machinery Company a various assortment of Mazda lamps of all sizes. The company was represented by W. J. McFadden.

J. B. Terry Company, Cedar Rapids, Iowa, exhibited a line of Bryant sockets, Hot-Point heating devices, National Metal Molding Company's material, Fort Wayne meters, Westinghouse fans, Cutler-Hammer specialties, Ever-Ready batteries, and Trumbull switches. The company was represented by A. A. Jeffrey.

Tri-City Electric Company, Davenport, Iowa, exhibited Chicago Fuse Manufacturing Company's fuses, Hawthorn fans, Westinghouse wire-type lamps, Holophane glassware and Moloney transformers. N. Butterworth was in charge.

Vacuum Machinery Company, Davenport, Iowa, exhibited a line of portable and stationary vacuum cleaners and accessories. The company was represented by W. F. Turtle.

Voss Brothers Manufacturing Company exhibited in operation three electric washing and wringing machines. The company was represented by H. F. Voss and G. K. Cardwell.

Wagner Electric Manufacturing Company, St. Louis, Mo., maintained a comprehensive display of transformers, single and polyphase motors, generators, instruments, and also exhibited in operation a new type of rectifier for charging storage batteries. The company was represented by W. R. Patton, H. W. Briscoe and H. E. Griffin.

Western Electric Company, Chicago, Ill., showed a complete line of motors, transformers, fans, washing machines, toasters, percolators, vibrators, flat irons, meters, street-railway telephones, interphones, vacuum cleaners, tungstoliers, and Sunbeam lamps. C. L. Goldin, W. T. Hoagland, T. J. Rider, Jr., and C. E. Roberts were in attendance.

Western Valve Company, Chicago, Ill., exhibited Fairbanks valves, Pratt-Cady valves, asbestos-packed cocks, fire hydrants and Dart unions. Quay T. Stewart was in attendance.

Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., exhibited a complete line of electric heating devices, comprising toasters, sad irons, chafing dishes, milk warmers, radiators, etc.; fan motors, including air and mechanically operated oscillators, desk and exhaust fans; watt-hour meters, testing instruments; railway line material; sewing machine and small power motors, wire-type tungsten lamps of all sizes, various sizes of transformers and lightning arresters. The company was represented by W. R. Pinckard, A. M. Miller, H. H. Coughlan, W. E. Gant, C. W. Regester, H. L. Garbutt, F. O. Creager, H. G. Glass, C. R. Wood, J. W. Busch and C. Durland.

White Lily Manufacturing Company, Davenport, Iowa, exhibited the White Lily washing machine. A feature of this exhibit was a pyramid of washing machines in operation, studded with multi-colored incandescent lamps. The exhibit was in charge of H. W. Power.

The following were in attendance, although not connected with any of the exhibits: J. S. Adelberg, Century Electric Company; J. F. Hennesy, Pennsylvania Steel Company; C. P. Dickerson, American Car & Foundry Company; R. L. Brown, National Lock Washer Company; P. F. Lyons, National India Rubber Company; D. H. Wyre, Buckeye Electric Company, P. W. Mendt, Standard Motor Truck Company; L. Heitmeier, Wesco Supply Company; W. Y. Atkins, American Electrical Works; R. Green, Standard Underground Cable Company; A. S. Merrill, Chicago Fuse Manufacturing Company; C. W. Wilkins, National Carbon Company; F. C. Gibbs, Dearborn Drug & Chemical Company; C. W. Rhoades, St. Louis Surface & Paint Company; J. Mendenhall, National Lead Company; C. Dennis, Excess Indicator Company; W. Smythe, Jr., Fiber Conduit Company; W. J. Crawford, J. A. Roebling & Sons Company; V. A. Swet, Sprague Electric Company; W. E. Bishoff, W. N. Matthews & Brother; R. Deneen, Ohio Brass Company; H. Watson, Benjamin Electric Manufacturing Company; P. J. Cratty, American Circular Loom Company; W. H. Van Skaik, Shelby Electric Company; J. Boyd, Columbia Incandescent Lamp Company, and H. A. Johnson, Pacific Electric Heating Company.

EXHIBIT OF THE ALLIS-CHALMERS COMPANY AT DAVENPORT, IA.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Max E. Schmidt, president of the Continuous Transit Securities Company, which is seeking to build a moving platform system in Manhattan, has sent a letter to Chairman Willcox of the Public Service Commission calling his attention to the fact that the plan of the Brooklyn Rapid Transit Company would seriously interfere with the moving platform construction. He said:

"Under date of June 1, 1909, this company made a proposition for construction and operation, at its own expense, of two moving platform subways, one in Broadway from Tenth, or Fourteenth, to Forty-second Street, and another in Thirty-fourth Street across town from Second to Ninth Avenue.

"Quite recently, the Brooklyn Rapid Transit Company has made a proposition including a demand for a subway in Broadway, Manhattan. Such a subway, if located above the Hudson tubes at the intersection of Thirty-fourth Street and Broadway, would not only seriously interfere with our proposition, but would make the location of a cross-town subway on Thirty-fourth Street extremely problematical. We trust that in comparing the proposition of the Brooklyn Rapid Transit Company with that of this company you will give due consideration to the fact that there is no room above the Hudson tubes at Thirty-fourth Street and Broadway for two additional train subways, but quite sufficient room for two moving platform subways."

The Public Service Commission, Second District, has received a complaint from Charles C. Duryee, mayor of the city of Schenectady, directed against the rate of fare charged by the Schenectady Railway Company within that city. He alleges that the rate of five cents is excessive and unreasonable, and that a maximum rate of four cents would be a just and reasonable rate, returning to the railroad company ample revenues for the operation, maintenance and improvement of its railway properties and service, and rendering in addition thereto a reasonable profit upon the investment. The petition alleges that prior to March, 1909, the company was transporting many of its passengers for 4.16 cents per passenger, which rate was yielding ample revenue, and that at this time it obtained many franchises from the city of Schenectady, upon the agreement, express or implied, that such rate would be maintained, but that, since March, 1909, the company has charged five cents for the transportation of passengers, except for school children at certain hours of the day.

The Public Service Commission, Second District, has authorized the Marion Power Company to construct and operate an electric lighting plant in the village of Marion, Wayne County, and also along the highway leading north to the division line between the towns of Marion and Williamson. The village is to be supplied with Niagara power through the Rochester Railway & Light Company. The company has asked permission from the Commission to issue $8,000 in common capital stock and for authority to execute a mortgage for $10,000 for the purpose of defraying the expenses of construction of the new plant.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

A complaint was lodged with the Commission by twenty-five consumers in the city of Marshfield directed against the Wisconsin Telephone Company and J. C. Marsh. The complaint states that J. C. Marsh operates a local exchange in the city and that he exacts from the patrons of his exchange twenty-five cents per month or three dollars per year additional to the charges for telephone connections with his local exchange, said additional charge being for the privilege of having long-distance connections with the wires and exchanges of the Wisconsin Telephone Company. The complaint alleged that this additonal charge was excessive and a discrimination against the patrons in Marshfield. The complaint also stated that all patrons of the local exchange who did not have long-distance connections as described above were charged ten cents each time such patrons were called to answer long-distance calls. This charge was also held to be excessive and unreasonable. The Commission in its decison goes into a rather exhaustive analysis of the history and reasons for the extra charges described in the complaint and also points out that an investigation of the earnings and expenses of the local exchange show that it is in good financial condition and is earning a fair rate of return upon the investment and does not stand in need of the extra revenue derived from the charges above mentioned. The charge of $3 per year for the long-distance connection with the Wisconsin Telephone Company is made under a contract between the local exchange and the Wisconsin Telephone Company. This charge is analyzed by the Commission and the investment made necessary by the long-distance connection is described. The Commission states: "Since by renting the instruments in question the Marshfield exchange is relieved from the outlays involved in the purchase and maintenance of the same, there might be some justification for a rental charge in this case that about equals a fair amount of interest on the investment and the depreciation and repair charges involved which, as stated, would not seem to amount to much more than fifty cents per subscriber per year. It is, of course, a fact that in this case, too, line connection with the Wisconsin Telephone Company is of considerable value to the Marshfield exchange and its subscribers. Under the law, however, this value is covered by reasonable compensation for the joint services that arise from such connections. For it is a fact that joint rates are subject to the same rules in this respect as local rates." The Commission ordered the Marshfield exchange to discontinue its monthly charge of twenty-five cents for toll or long-distance connection with the lines of the Wisconsin Telephone Company from those among its subscribers who are equipped with Bell and Western Electric Company's instruments, and also to discontinue its calling charge of ten cents for long-distance service from among those subscribers who are not equipped with the instruments in question.

The Evansville Telephone Exchange petitioned the Commission for authority to increase its rates to certain classes of subscribers on the grounds that the present rates are not remunerative; that the company has expended considerable money improving and extending its system; that the number of telephones has nearly doubled since the present rates were established, and that the cost of maintenance and operation has increased. The company claimed a valuation somewhat higher than that determined by the staff of the Commission and the excess was found to be caused by the cost of replacements which should have been provided for from a depreciation fund. It was found, however, that the company had not been able to pay any dividends in its early years of operation and had been unable to set aside any depreciation fund from the earnings. In view of these facts the Commission stated that the cost of reproduction of the property would perhaps more nearly measure the investment than the present value. An analysis of the earnings and expenditures of the plant showed that even upon the liberal investment claimed by the utility the rate of return was equal to 14.3 per cent on the investment and no increase was called for. The Commission stated, however, that the rates indicated that perhaps the charges were not very equitably apportioned among the several classes of service, but that the condition of the books and records of the company were such that it was impossible at this time to determine with reasonable accuracy a correct distribution of the expenses. The company also asked for permission to discontinue the four-party service, as it was claimed that this service was not paying its cost. This petition was denied by the Commission because of the fact that the records of the company did not prove the assertion. The Commission stated that when the reports of the company are made in accordance with the prescribed classification of accounts it will be possible to make an investigation which will show the cost of each class of service. Until this time the rates are to be left as at present.

LIGHTING AND POWER.

(Special Correspondence.)

ROLAND, IA.—This city will vote on an $8,000 electric light plant bond issue. P.

GLEN ULLIN, N. D.—There is an agitation for the installation of an electric light plant. C.

ELDORA, IA.—The Park Dam Power Company will put in an electric light plant here to cost $10,000. P.

LANGFORD, S. D.—A franchise has been granted to the C. B. Hersey Company to install an electric light plant. P.

JEWELL, IOWA.—Subscriptions are being secured for the erection of an electric light plant to cost $12,000. C.

UKIAH, CAL.—J. A. Foster and J. L. Davis have been granted an electric lighting franchise in this city and county. A.

KEOSAUQUA, IOWA.—A franchise has been voted to J. A. Johnson for the installation of an electric light plant. C.

SUMNEYTOWN, PA.—An electric light plant will be built by James S. Miller, and power will be furnished to the village.

MANILA, P. I.—The Bagino Electric Light Company's plant was recently bought at auction by the government for $12,500.

KELSO, WASH.—A franchise has been granted to the Washington-Oregon corporation to install an electric light system. C.

REDFIELD, IOWA.—It is proposed to issue bonds for $15,000

for the establishment of an electric light and water works plant in this place. C.

EL PASO, TEX.—Fort Bliss is to be electrically illuminated, power being supplied by the Electric Railway Company in this place.

KLAMATH FALLS, ORE.—The Klamath Falls Light & Water Company has been granted a franchise to furnish electric light in this city. A.

BROWNSVILLE, ORE.—The Oregon Power Company has bought out the Brownsville Electric Light & Power Company and plans to rebuild the system.

MOUNTAINSIDE, N. J.—It is reported that an independent electric light company is to be organized here. The capital stock will probably be about $25,000.

BLUEFIELD, W. VA.—The new street lighting system is being installed and will probably be completed in a short time. Ornamental lamp posts will be used.

MUSSELSHELL, MONT.—The contract for the installation of an electric light plant has been let to Fairbanks-Morse Company. It is to be completed June 1. C.

AUBURN, CAL.—The Great Western Power Company has been granted a franchise for a power line in this city and also a franchise along the Rocklin-Folsom Road. A.

CULVER, ORE.—The Cove Power Company, composed of Prineville, Ore., men has begun the construction of a power plant on Crooked River, two miles west of this city. A.

ELGIN, ORE.—The McCully-Rumble Land & Power Company has been granted a power franchise in this city. Construction work on a power house will be started this summer. A.

ALAMEDA, CAL.—The City Council has appropriated $3,000 for a power line to supply current for operating the turning motors on the three drawbridges across the tidal canal.

SAN FRANCISCO, CAL.—The West Coast Power Company has been incorporated by S. E. Bretherton, H. P. Anewalt, I. J. Broberg, M. F. Vandall and G. O. Perry, with a capital stock of $500,000. A.

LOWELL, MASS.—A scheme is being considered for installing a lighting plant at the city hall so that light and power may be furnished to the city hall, high school and other public buildings.

KANSAS CITY, MO.—The Costelow-Canham Electric Company has been incorporated with capital stock of $3,000. The incorporators are John F. Costelow, E. E. Canham, Sr., and E. E. Canham, Jr. Z.

JIM FALLS, WIS.—It is understood that H. M. Byllesby & Company, Chicago, have secured an option on the new dam here at $1,000,000 and will use it for the transmission of electric power to Minneapolis and St. Paul. C.

MINONK, ILL.—The Union Light & Power Company has been incorporated with a capital stock of $100,000 to furnish electricity and gas. The incorporators are G. Frank S. Ames, S. C. Kipp, Charles S. Robinson and J. S. Webber. Z.

NEW RICHMOND, WIS.—The plant of the St. Croix Power Company at Apple River Falls, twelve miles west of here, owned by the St. Paul Gas Light Company, St. Paul, was recently wrecked by an explosion. The loss was $500,000. C.

MISSION, TEX.—The Mission Land and Improvement Company will install an electric light and power plant and a complete water works system here. The company has also taken steps to install a large ice and pre-cooling plant here. D.

BUFFALO, MO.—An electric light plant, running in conjunction with the flour mills, will be installed by James Bonner. Only a lighting load will be maintained at present, but provision will be made for supplying manufacturing plants in the future.

CHEHALIS, WASH.—The Twin City Light & Traction Company has been granted a fifty-year franchise to operate an electric lighting plant in the city. The company will this year erect a $75,000 power house near the present one on Coal Creek. A.

BRAINERD, MINN.—This city is now receiving power from the Toltz Engineering Company of St. Paul which has a contract to supply current for the next ten years. The generating machinery was supplied by the Minneapolis Steel & Machinery Company.

KLAMATH FALLS, ORE.—The Siskiyou Electric Light & Power Company has started construction work on a dam at the head of Ward's Canyon, sixteen miles above Hornbrook on the Klamath River. The dam is to be 250 feet long and ninety feet high. A.

CLINTON, MASS.—The factory of the Bigelow Carpet Company has adopted individual drive for its machines. So far 122 motors have been installed, the majority of which are running single looms. About as many more motors are to be installed before the plant is fully equipped.

DAYTON, WASH.—The Dayton Electric Company has been granted an electric lighting franchise in this city. The Pacific Light & Power Company, formerly operating in this city, has transferred to the Dayton Electric Company all its holdings and interests in Dayton. The transaction involved about $200,000. A.

DURHAM, N. C.—The Southern Power Company has purchased land upon which it will build its distributing station when its high-voltage lines reach Durham. Twenty thousand available horsepower in Durham, about 3500 of which is supplied in emergenies by the Durham Traction Company, will be the prospect of the new ompany.

CHARLOTTE, N. C.—The Proximity Manufacturing Company and the White Oak Cotton Mills of Greensboro have arranged with the Southern Power Company of this city for secondary power, which will be furnished at the White Oak power station of the mills. The cost of making the change will amount to several thousand dollars.

NAVY YARD, PUGET SOUND.—The new half-million-dollar central power plant which has been under construction here for the past two years will be placed in operation about the middle of next month. The new plant will generate electrical power and light for use throughout the yard and furnish compressed air for the operation of drills and other machinery.

WELLSBURG, W. VA.—It has been announced here that the plant and franchise of the Wellsburg Electric Light and Power Company was recently taken over by the Ohio Valley Scenic Company of East Liverpool, for a consideration said to between $20,000 and $25,000, possession being taken immediately. Secretary E. A. Sheets will be retained by the new owners.

GREENSBORO, N. C.—Papers of incorporation for the North State Hydro-Electric Company, with an authorized capital stock of $300,000, have been filed at Raleigh. The incorporators are: A. C. Wyckoff, H. L. Parker and F. H. Briggs, all of Raleigh. The company, it is stated, is a subsidiary company of the Carolina Power & Light Company and the Yadkin River Power Company.

TROY, ALA.—A $50,000 electric light plant is to be erected in Troy by the Standard Chemical & Oil Company, a local fertilizer, oil and ice concern. Contracts will soon be completed for the machinery and supplies for this plant, only a few details of minor importance remaining. In all probability the new plant will be located at the new mill of the company two miles north of Troy.

SAN BERNARDINO, CAL.—D. R. Paramour has filed on 3,000 inches of Bear Creek water, and plans, under the name of the Union Power Company, to supply electric energy in San Bernardino, Riverside, Orange and Los Angeles counties. Two power sites have been selected in Bear Creek Canyon. Mr. Paramour states that the water is to be conveyed to the power houses through concrete tunnels. A.

FRESNO, CAL.—Work will be begun immediately upon the building of the West Side electric power line which is to connect Bakersfield with the big power plant of the San Joaquin Light and Power Corporation at Crane valley. After leaving Fresno the line will run via the Summit lake, Tulare lake and Lost Hills oil field to Bakersfield. It will be 195 miles in length and operate at 60,000 volts.

CROWLEY, PA.—Machinery has arrived for the new light plant here and the system will be in use in a short time. The new installation is valued at $15,000. The city power plant was burned September 18, 1909, and a temporary plant was patched up to supply water and light. The new installation will supply the city, including street lighting, which has been inadequate since the destruction of the old power house.

CHARLOTTE, N. C.—The American Spinning Company of Greenville, will install the electric drive to displace steam power in its No. 1 mill. This change will require the installation of a 600-horsepower motor and contract for this machine has been awarded. The electricity will be obtained from the Greenville transmission lines of the Southern Power Company of this city. The American plant has about 52,500 spindles and 1,100 looms, on yarn and cloth production.

ASHLAND, PA.—The large power plant of the P. & R. Coal and Iron Company, which has been in course of construction for more than a year at the Locust Spring colliery, at Locust Gap, is nearly completed and same tests have already been made. The company will have seven slopes and shafts with its necessary large underground openings, together with the breaker, engine rooms, fire rooms, etc., to supply at this one colliery, and will also furnish light and power at the Alaska and the Potts collieries.

KINGSLAND, TEX.—C. M. Alexander, of Dallas, who is at the head of the Colorado River Power Company that is building a large reinforced concrete dam and installing a hydroelectric plant at Marble Falls, Tex., is arranging to establish a similar enterprise on the Colorado River near here. He has selected the site for the proposed dam and acquired the land in the valley that is to be overflowed by the water storage reservoir. The capacity of the hydroelectric plant will be about 10,000-horsepower, it is stated. It will be operated in connection with the plant at Marble Falls. The dam that Mr. Alexander and associates are to construct near here will be of the same open-chamber type as the one that they are building at Marble Falls. Electric power transmission lines will be constructed from these two hydroelectric plants to towns and cities within a radius of 150 miles, tentative contracts for the sale of the power having already been entered into with a number of industrial concerns. Within this radius are located San Antonio, Austin, Waco, Temple, Belton, Llano, Burnet, Lampasas, Taylor, Georgetown, San Marcos, New Braunfels and many other towns of smaller size. D.

ELECTRIC RAILWAYS.

(Special Correspondence.)

MT. CARMEL, ILL.—The City Council has granted a franchise to the Evansville, Mt. Carmel & Olney Traction line to enter the city over Market and Mulberry Streets. S.

BENTON HARBOR, MICH.—An effort will be made to run cars to Indian lake over the Dowagiac interurban line by July 4. Arrangements have been already made for the disposal of a $200,000 bond issue.

SAN FRANCISCO, CAL.—The Oakland, Antioch & Eastern Railway Company has been incorporated by S. L. Naphtaly, A. W. Maltby, L. Arnstein, J. R. Selby and A. J. Koutmeyer with a capital stock of $80,000. A.

PENTWATER, MICH.—A proposition is being considered for the construction of an electric line between this place and Walkerville, a distance of about twenty miles. If the road is built, a bonus of $50,000 must be furnished to the promoters.

CHESTER, PA.—The franchise of the Southwestern Street Railway Company, with all of its real estate and equipment, was sold at public sale to David Wallerstein for $177,000. The line extends from Otsego and Mifflin stations to Bow Creek and is operating only six of its twenty-two cars.

GLOVERSVILLE, N. Y.—Announcement has been made of the formation of a company for the building of an electric railway from Johnstown to Little Falls. It is expected the road will be in operation before the end of 1912, thus completing the chain of electric railways from Hudson to Buffalo.

BALTIMORE, MD.—It is stated that more than $110,000 of the authorized $200,000 stock of the Kent Traction Company, which proposes to construct a trolley line from Tolchester to Chestertown, ten miles, has been subscribed. There is a possibility that the road will later be extended to Centerville, Easton, Hurlock, Salisbury and Crisfield.

FRESNO, CAL.—The Hanford & Summit Lake Railroad Company will extend its line from Hardwick, in Kings County, to Jamison, twenty-six miles west of this city. The line will be thirty-six miles in length, and, with the exception of four miles, will be located in Fresno County. Work on the new road is expected to begin in a very short time. A.

BRIDGEPORT, CONN.—The New Haven Railroad is planning to supply power for the operation of street railways in all of the towns through which the main line runs east from Cos Cob as far as Bridgeport. The Cos Cob plant now supplies the power for the Greenwich lighting plant, which is owned and operated by the Connecticut Company, and preparations are being made to supply power for the street railways in White Plains, Mamaroneck and Portchester, N. Y., and Stamford, South Norwalk, Norwalk and Bridgeport, Conn.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

KALAVALA, MINN.—The Kalavala Farmers Telephone Company will build a line to Moose Lake. C.

HARRISBURG, PA.—The Fort Loudon & Cove Gap Telephone Company of Franklin County has been chartered with a capital of $5,000.

DAYTON, WASH.—Farmers have organized the Mount Vernon Telephone Company to construct a line twelve miles long to Mount Pleasant. C.

LA CROSSE, WIS.—The La Crosse Telephone Company has secured a site for construction of a telephone building estimated to cost $20,000. C.

MONTICELLO, ILL.—The local telephone company and the Atwood Mutual Telephone Company will build a direct through toll line between Monticello and Atwood. Z.

MORA, MINN.—The Knife Lake Telephone Company, Axel Lundberg, secretary, has commenced the construction of a nine-mile extension of its line in Knife Lake town. C.

TEXARKANA, KAN.—Announcement has been made of the sale of the Kizer Telephone Company, an independent line, connecting Texarkana with Mena and Mena with Ashdown and Bokhoma, to the Southern Telephone Company. The new owners have taken charge of the property.

MANITOWOC, WIS.—The Wisconsin Telephone Company has started work upon construction of a fourth toll line between Milwaukee and this city. W. D. Quinlan, former district manager of the Green Bay district, of which this city is part, who resigned to go West for his health, has returned and succeeds H. Minery as district manager.

ROSWELL, N. M.—The transfer of all telephone lines from Melrose, N. M., east on the Belen cut-off and thence south to and including Artesia, was made recently from the local companies to the Colorado Telephone Company, a branch of the Bell system. The price approximates $300,000. John W. Pope, E. A. Cahoon, J. P. Crouch and L. K. McGaffey, all of Roswell, owned all of the stock in the three companies.

ELECTRICAL SECURITIES.

Although the week has been more active in stocks there has been a loss in the value of many securities. While there was an increase in bond transactions, the change in values was fractional. Reading, steel and Union Pacific stock lead the market and the total volume of trading amounted to three times that of the previous week.

There has been admitted to the regular trading list on the Chicago Stock Exchange an additional issue of $6,250,000 Western Electric Company first mortgage five-per-cent gold bonds, making total now listed $15,000,000.

A mortgage to secure $15,000,000 thirty-five-year five-per-cent gold bonds has been filed by the Yadkin River Power Company, in the deed from the Rockingham Power Company, now being registered at Wadesboro, N. C. This includes the Blewett Falls property, which recently underwent reorganization.

The city council of Saskatoon has been asked to guarantee bonds of the Saskatchewan Power Company to an estimated amount of $836,000, the company promising to give the city fifty-one per cent of the common stock and a controlling representation on the board.

At the annual meeting of the Marconi Wireless Company of America, the following directors were elected to serve for five years: Charles A. Terry, New York; Major S. Flood-Page, London; and Godfrey C. Isaacs, London. John W. Griggs was elected president, and Guglielmo Marconi and John Bottomley first and second vice-presidents.

DIVIDENDS.

Cape Breton Electric Company; common semi-annual dividend of $2 and preferred of $3, payable May 1.

Cities Service; common monthly dividend of one-quarter per cent and preferred of one-half per cent, payable May 1.

Commonwealth Power, Railway & Light Company: preferred quarterly dividend of one and one-half per cent, payable May 1.

Connecticut Railway & Lighting Company; common quarterly dividend of one per cent, and one per cent on preferred, payable May 15.

Hartford & Springfield Street Railway Company; regular semi-annual dividend of three per cent on the preferred stock, payable May 1 to stock of record April 20.

Lewiston, Augusta & Waterville Street Railway Company; one and one-half per cent on preferred, payable May 1.

Ohio Traction Company; quarterly dividend of one and one-quarter per cent, payable May 1.

Pacific Power & Light Company; regular quarterly dividend of one and three-quarters per cent on preferred stock, payable May 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	April 24.	April 17.
Allis-Chalmers common	7¼	7½
Allis-Chalmers preferred	26	29
Amalgamated Copper	61⅛	62⅜
American Tel. & Cable	*80	*80
American Tel. & Tel.	144¾	145½
Brooklyn Rapid Transit	76⅝	77¾
General Electric	150¾	150⅛
Interborough-Metropolitan common	17¼	18½
Interborough-Metropolitan preferred	48¼	52¾
Kings County Electric	123	129
Mackay Companies (Postal Telegraph and Cables) common	90½	90½
Mackay Companies (Postal Telegraph and Cables) preferred	75	76¼
Manhattan Elevated	135	136
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	48	50½
U. S. Steel common	73⅝	77
U. S. Steel preferred	119	119½
Western Union	71½	72¾
Westinghouse common	64½	65½
Westinghouse preferred	110	117

*Last price quoted.

BOSTON.

	April 24.	April 17.
American Tel. & Tel.	144¾	145½
Edison Elec. Illuminating	285	283
General Electric	150¾	150½
Massachusetts Electric common	16	16¾
Massachusetts Electric preferred	86¾	87½
New England Telephone	140	142
Western Tel. & Tel. common	18	19
Western Tel. & Tel. preferred	92	93½

PHILADELPHIA.

	April 24.	April 17.
American Railways	44⅝	44¾
Electric Company of America	11⅞	11⅝
Electric Storage Battery common	52	52½
Electric Storage Battery preferred	52	52½
Philadelphia Electric	16½	16¼
Philadelphia Rapid Transit	17½	18¼
Philadelphia Traction	82½	84
Union Traction	45½	46½

CHICAGO.

	April 24.	April 17.
Chicago Railways, Series 1	80	83
Chicago Railways, Series 2	22	23
Chicago Subway	4¾	4½
Chicago Telephone	121½	118½
Commonwealth Edison	123½	128
Metropolitan Elevated common	21	22
Metropolitan Elevated preferred	65	68

PERSONAL MENTION.

R. L. MacDUFFIE has been appointed treasurer of the Pay-As-You-Enter Car Corporation.

CHARLES P. STEINMETZ of the General Electric Company recently delivered a series of two lectures on "Electrical Energy" before the students of the college of engineering of the University of Illinois.

LEVI L. PAXTON, for the past six years superintendent of motive power of the Evansville & Southern Indiana Traction Company, has resigned and will be succeeded by L. E. Butler, of Kendallville, Ind.

EDWARD C. SPRING, traffic manager of the Lehigh Valley Transit Company, with headquarters at Allentown, Pa., has been promoted to the position of general manager of the Philadelphia & Western line.

JAMES CAMPBELL has been elected president of the Milwaukee Electric Railway & Light Company. Mr. Campbell is president of the North American Company, which controls the Milwaukee concern. He succeeds John I. Beggs, resigned.

WALTER R. ARMSTRONG, who was recently made president and general manager of the Federal Miniature Lamp Company of Cleveland, O., is one of the best known persons in the miniature incandescent lamp business. Mr. Armstrong's experience in lamp manufacture dates back to 1886, and for the past twenty years he has made a special study of miniature and novel types of lamps. Personally, one of the most expert lamp makers in this country, he has a rare ability in teaching the art efficiently to others, and has thus developed a corps of specialists thoroughly skilled in the delicate, exacting operations of miniature lamp making. During the past four years Mr. Armstrong has given much attention to the perfecting of a high-efficiency incandescent lamp for automobile head-light service, and has worked on the automobile-lighting problem in co-operation with the engineers of a large number of storage-battery, generator and automobile manufacturing concerns. The factory of Mr. Armstrong's company is of very recent and thoroughly modern construction, and carries a stock of over 500,000 lamps, the largest single stock of miniature lamps in the world.

W. R. ARMSTRONG.

HUGH J. McGOWAN, president of the Indianapolis Traction & Terminal Company, and also of the Terre Haute, Indianapolis & Eastern Traction Company, has returned to his home in Indianapolis, after a winter's sojourn in California. Mr. McGowan speaks highly of the traction development on the Pacific coast.

CHARLES AUSTIN HOWE, manager Chicago office of the Holophane Company, has resigned his position to become treasurer and general manager of the Holophane Company, Limited, of Canada, with headquarters at Toronto. Mr. Howe has been connected with the Holophane Company for the past ten years and resigned the position of sales manager to accept charge of the Chicago office four years ago. Since coming to Chicago Mr. Howe has taken an active interest in electrical happenings and was recently elected vice-president of the Chicago Electric Club. He is also a member of the Illuminating Engineering Society and has delivered many addresses on the subject of illumination. Paralleling the announcement of Mr. Howe's well deserved advancement is the announcement that on Saturday, April 29, he will wed Miss Helen Louise Atwood, of Chicago. Mr. Howe is an esteemed and popular member of the electrical fraternity and his many friends concur in extending their hearty congratulations.

C. A. HOWE.

THEODORE N. VAIL, president of the American Telephone & Telegraph Company and the Western Union Telegraph Company, who is now in London, was strongly urged to permit his name to be used as a candidate for Governor of Vermont. Mr. Vail is one of the leading landed proprietors of that state, owning a farm of 5,000 acres at Lyndonville. He was telegraphed to a few days before he sailed as to the truth of the report that Vermont might claim him for its new Governor. Mr. Vail responded promptly as follows: "I am not seeking nor would accept any such preferment. These rumors were started in Vermont to get at my position, but I have expressed the same sentiment there that I do here. Of course I am grateful for the implied compliment."

OBITUARY.

ROBERT WEBB MORGAN died suddenly of pneumonia on April 17 after an illness of only six days. Mr. Morgan was born at Tarrytown, N. Y., 1864. His father was N. Dennison Morgan, one of the leading financiers of New York of his time, and a founder of the Mutual Life Insurance Company. Mr. Morgan was educated at St. Paul's School, Concord, N. H., and later at Garden City, N. Y. Previous to his engaging in the electrical business, he was purchasing agent for the Wagner Palace Car Company. After the consolidation of this company with the Pullman Company, he organized and was president of the Globe Printing Company. In 1901 he established the Anchor Lamp Company, and was its first president; and in 1908 the Aetna Lamp Company, of which he was also president. Mr. Morgan lived at Bronxville, N. Y., and was buried at Kensico, N. Y. He leaves a widow. He was a member of the Society of Colonial Wars, and one of the charter members of the Military Order of Foreign Wars of the United States, of which organization he was Deputy Secretary.

LEGAL NOTES.

A TELEPHONE COMPANY NOT SUBJECT TO LICENSE TAX.—Where a telephone company owns no property of any description within a town, has no franchise from it, does no business within the town, directly or indirectly, through the agency of others, but only makes telephonic connection outside of the limits of the town with a wholly separate and independent corporation, which pays taxes on all of its property within the town and has a license from the town to do a telephone business, the Supreme Court of Appeals of Virginia holds that the town has no authority to require a license of the first-mentioned company.—Southern Bell Telephone & Telegraph Company vs. Town of Harrisonburg, 69 S. E. 348.

LIQUIDATED DAMAGES.—It has often occurred in connection with contracts for Government work that the performance of work or the furnishing of material thereunder have not been completed within the time required and that the engineers in charge of the work have stated that no damages were suffered by the United States. The comptroller of the Treasury has held that it is not necessary to inquire or consider whether the Government suffered any actual damage or not, but that in a proper case where the parties to the contract have agreed upon and liquidated the damages that will be sustained in the event of a breach of the contract, neither party will be permitted to be heard to say that there were no damages. This decision followed the holding of the United States Supreme Court in United States vs. Bethlehem Steel Company, 205 U. S., 121.

NO ABSOLUTE RULE AS TO DUTIES TO AND OF LINEMEN.—The Supreme Court of Alabama says that it thinks the truth to be that no absolute, positive, or invariable rule can be announced, which will apply to every case, and which will correctly define the duties of electric companies to their linemen in all cases, or the duties of the linemen to the companies, or define the risks which the linemen assume in all cases. The duties and liabilities of the electric company, and the duties, risks, and rights of the linemen, as to the inspecting and maintaining of electric poles, must of necessity depend upon the circumstances of each particular case. The degree of care required of both parties, and the risks incident to the employment, and which are assumed by the respective parties, master and servant, are to be measured and determined in each particular case, to some extent at least, by the contract or terms of employment, and by the rules and customs of the master.—Mobile Electric Company vs. Sanges, 53 So. 176.

NEW PUBLICATIONS.

ELECTRICITY.—A new quarterly journal entitled *Electricity* has been launched in Australia, and two numbers have already appeared. The field covered by the new journal appears to be largely a popular one, with the object of increasing the use of electrical devices and machinery in its home field. The publisher is Peter G. Tait, 63 Queen Street, Melbourne.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—The procedings of the eighteenth annual meeting of this society, held in Madison, Wis., last June, has been issued. It contains a number of interesting articles on instruction in technical and scientific subjects. The proceedings are in two volumes and are issued by the secretary, Prof. H. H. Norris, Cornell University, Ithaca, N. Y.

NEW YORK COMMISSION REPORTS.—The Public Service Commission of New York, Second District, has published, in two volumes, its third annual report, covering the year ended December 31, 1909. Volume I gives a resumé of the work of the Commission together with the cases coming up for consideration during the year. These are systematically arranged under their various heads. Volume II is confined to abstracts of the reports of corporations.

CANADA'S ASBESTOS INDUSTRY.—A second and enlarged edition of the report on asbestos has been issued by the Department of Mines, Ottawa, Canada. The report has been prepared by

Fritz Cirkel, and the text has been largely rewritten and much new matter added. It fills 316 pages and deals with the location of asbestos deposits, the physical and chemical properties of asbestos, its quarrying, preparation, cost of extraction and commercial applications. A chapter is devoted to asbestos in foreign countries and a bibliography of the subject is appended.

ARGENTINE TARIFF LAW.—The Pan-American Union, Washington, D. C., is issuing a series of bulletins on the tariff laws of the South American countries. The first of these, dealing with the Argentine Republic, has appeared. Some of the duties on Argentine imports are as follows: carbons for arc lamps, thirty-five per cent ad valorum; electric machinery and conduits, five per cent; copper wire and electric cables, five per cent; machinery for mine working, free; materials and apparatus for electric railways, free; all other electrical apparatus, twenty-five per cent. The charge for this bulletin is twenty-five cents.

PROPOSALS.

POST OFFICE, PHOENIX, ARIZ.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 19, for the construction (including plumbing, gas piping, heating apparatus, electric conduits, and wiring), of the United States post office and court house at Phoenix, Ariz., in accordance with drawings and specifications, copies of which may be had from the custodian of site at Phoenix, or at the Supervising Architect's office.

POST OFFICE, RICHMOND, VA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 8, for the installation of conduit and wiring and lighting system in the reconstruction of the United States post office, court house and custom house building at Richmond, Va., in accordance with drawings and specifications, copies of which may be had at this office or at the office of the superintendent of construction at Richmond.

LIGHTING PLANT, CHILLICOTHE, MO.—Sealed proposals will be received until May 8, by Ira T. Graham, city auditor of Chillicothe, Mo., for furnishing tools and labor and constructing a complete municipal electric lighting and power plant in accordance with plans and specifications now on file with him and also at the office of Fuller-Coult Company, Chemical Building, St. Louis, Mo. Engines, generators, line material, etc., are to be bid on. The work has been divided into ten sections and proposals will be received on any section or on the whole plant.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.	Place of Delivery.	Schedule Number.
May 9—	Bells, watertight, vibrating	50	Brooklyn, N. Y.	3515
	Cable, telephone	Miscellaneous.	Charleston, S. C.	3509
	Cable, oil proof	15,000 feet	Wash'ton, D. C.	3510
	Lamps, arc	100	Brooklyn, N. Y.	3509
	Transformers, auto	10	Brooklyn, N. Y.	3509
	Wire, magnet	Miscellaneous.	Brooklyn, N. Y.	3515
May 23—	Conductor, single	3,000 feet	Puget Sd., Wash.	3524
	Sets, testing, portable	20	Mare Island, Cal.	3524

NEW INCORPORATIONS.

INDIANAPOLIS, IND.—The Foxworthy Electric Company has incorporated to manufacture and deal in electrical equipment, devices anad supplies. M. K. and E. H. Foxworthy and L. R. Miller, directors. S.

NEW YORK. N. Y.—The Electric Seal & Stamp Company has been incorporated with a capital of $25,000 to manufacture electric seals, etc. The incorporators are David A. Sterling, William G. Lovatt and Charles J. Kleber.

NEW YORK, N. Y.—The Eclipse Light Company has been incorporated with a capital of $50,000 to manufacture gas and electric fixtures, etc. The incorporators of the compapny are L. B. London and F. Caplan of Brooklyn, and M. Bernstein of New York City.

CHICAGO, ILL.—The Central Light Company has been incorporated with a capital of $50,000 to construct and operate electric light plants. The incorporators are M. J. Carvey, W. J. Stenson, R. D. Braden, J. V. Suneral and J. D. Campbell, all of Chicago.

NEW YORK, N. Y.—The Hasbrook Electric & Manufacturing Company has been incorporated with a capital of $100,000 to manufacture electrical and mechanical products. The incorporators are Augustus T. Hasbrook, Summit, N. J.; Isaac Josephson, New York City, and James T. Sullivan, New York City.

BRADFORD, PA.—The Universal Manufacturing Company has been incorporated, to manufacture and sell all kinds of electrical appliances and devices. The capital stock is $1,000,000. The incorporators are Elisha B. Cutler, Charles E. Foster, George W. Foster, Charles W. Randall and William H. Olmsted, all of Bradford, Pa.

ANDERSON, IND.—The Consolidated Automobile Company has incorporated with a capital stock of $50,000. The object of the company is to manufacture automobiles, automobile parts, motors and motor parts and other devices and appliances. Henry Nyberg, Harry W. Hamilton and Percy H. Doyle are the incorporators. S.

INDUSTRIAL ITEMS.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., has distributed a number of its publication, *Condulet Talks*, dealing with "ZC," "ZS," "ZD" and "ZX" condulets.

THE EASTERN ELECTRIC LAMP COMPANY, Boston, Mass., compares the old wax candle and the Eastern "Mazda" lamp on a mailing card which has been distributed.

THE MORRIS IRON COMPANY, New York, N. Y., has received a number of orders for export, covering its outdoor fixtures, the most recent being from Limon, Costa Rico, for 100 cast-iron arc-lamp posts.

WICKES BROTHERS, Saginaw, Mich., list a very complete stock of second-hand engines, pumps, electrical machinery, etc., in the April monthly stock list which has recently been distributed to the trade.

THE WALPOLE RUBBER COMPANY & MASSACHUSETTS CHEMICAL COMPANY announce a change in the location of the New York office, going into effect May 1. The new address will be 80-82 Reade Street.

THE GENERAL INCANDESCENT LAMP COMPANY, Cleveland, O., have prepared two price lists of rather unusual design which it is enclosing with a recent letter. The cover of the lists is a greatly enlarged reproduction of the "G-I" label.

PETTINGELL-ANDREWS COMPANY, Boston, Mass., has distributed the Spring Business Number of its monthly publication, *Juice*. The issue is devoted principally to fans, flatirons and other business getters which advance in popularity with the coming of summer.

THE HUNTER FAN & MOTOR COMPANY, New York, N. Y., has published an attractive catalogue of its "Tuerk" and "H.-E." fan motors. These types, which are made both for alternating current and direct current, are illustrated both as installed and in part and descriptions and prices are given throughout.

DANIEL J. HAUER, construction economist and consulting engineer, Park Row Building, New York, announces that it is his intention to devote his time entirely to consulting engineering and the introduction of methods of system and economy in contracting work. He invites correspondence or interviews with contractors.

THE TRIUMPH ELECTRIC COMPANY announces the removal of its Boston office from 101 High Street to 92 Pearl Street. C. A. Cotton is district office manager. This change of location was made necessary by the large increase in the volume of business and the necessity of having larger and more commodious quarters.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo. is sending bulletins describing its alternating-current rectifier, which is designed particularly for use in charging ignition and other small storage batteries for automobiles. The weights and dimensions of the rectifier sets are given as well as the prices, and several illustrations show the appearance of the rectifier as installed.

THE FLOUR CITY ORNAMENTAL IRON WORKS, Minneapolis, Minn., will in a short time distribute a new catalog of its lamp-standard department. The brochure will include a detailed description of the various "Corinthian," "Egyptian," "Capital" and Boulevard designs. The fact that all illustrations are made on the definite scale of one-half inch to the foot will increaese its value to those wishing to place orders.

H. T. PAISTE COMPANY, Philadelphia, Pa., is distributing its March condensed catalogue and price list of Paiste standardized wiring material. The supplies listed have been standardized as far as possible and the number of special types tending toward multiplicity of designs has been avoided. The new Paiste socket, which is especially featured, is described at length with an illustration. A color plate of Paiste pipe taplets is a feature of the bulletin.

THE COLUMBIA INCANDESCENT LAMP COMPANY, Philadelphia, Pa., which has for the past eight years been located in the Real Estate Trust Building, has recently moved its offices in order to serve its customers more efficiently. The new location is No. 639 to 641 Philadelphia Bourse Building, Fourth, Fifth, Market and Chestnut Streets. This move brings the offices and warerooms in the same building, enabling the company to handle shipments from its Philadelphia stock to much greater advantage than formerly. The new office opened April 17.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has received a number of orders for railroad equipment, among which was one for four quadruple equipments of No. 304 interpole railway motors for the Bowling Green & Southern Railway, of Findlay, O. The Georgia Railway & Electric Company, of Atlanta, has ordered six additional double equipments of No. 112 B-2 motors and the Johnston Passenger Railway Company, of Johnston, Pa., five double equipments of No. 93A motors. A number of other companies have recently ordered railway material in large amounts from the Westinghouse Company.

THE SCHAEFFER & BUDENBERG MANUFACTURING COM-

PANY, Brooklyn, N. Y., has issued a bulletin under the name of "The Indicator." This publication describes instruments of precision for indicating and recording pressure, temperature and speed. The company's instruments are exceedingly well known, as it is their policy that no instrument is allowed to leave the factory until the examiners are satisfied beyond all doubt that the instrument is properly designed, made and tested to go into service and do its work properly. In addition to a very complete description of each of the pieces of apparatus a number of half-tones of the instruments showing exteriors and also cross-sections are included.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has just issued a very attractive bulletin, which illustrates and describes its electric fans for the coming season. These fans are made for either alternating or direct current, and in various styles and sizes to meet various conditions. The publication lists fans suitable for the home, office and restaurant, and fans which can be placed on desk or table, or fastened to the wall or ceiling. The bulletin, which is No. 4806, lists also various small power motors. The company's bulletin No. 4799, sent out at the same time, describes in considerable detail several types of revolving-field alternators. Both horizontal and vertical shaft alternators are illustrated. Bulletin No. 4816 contains a description of a new running-light telltale board which has the approval of the Underwriter's Laboratories, and affords a reliable means of indicating whether or not the running lanterns are lighted. The board may be located in the pilot house and is so arranged that both an audible and visible warning is given on the failure of a lamp.

DATES AHEAD.

Arkansas Association of Public Utility Operators. Annual convention, Little Rock, Ark., May 3, 4 and 5.

American Foundrymen's Association, American Brass Founders' Association and the Associated Foundry Foremen. Annual convention, Pittsburg, Pa., May 23-26.

National Electric Light Association. Annual convention, New York City, May 24 to June 3.

Commercial Section, National Electric Light Association. Meeting and banquet, New York, N. Y., June 1.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

Association of Railway Telegraph Superintendents. Annual meeting, Boston, Mass., June 19-23.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Society for the Promotion of Engineering Education. Annual meeting, Pittsburg, Pa., June 26, 27 and 28.

Association of Railway Electrical Engineers. La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) April 18, 1911.

989,568. ELECTRIC FURNACE. Michael R. Conley, New York, N. Y., assignor to J. Esdaile Florence, trustee, New York, N. Y. Filed June 14, 1910. A one-piece electric resistance furnace having a melting chamber composed of material of relatively high resistance, and a body portion formed in the shape of integral arms extending from the sides of the melting chamber, and composed of material of better conductivity than that of the melting chamber.

989,576. TELEGRAPHY. Patrick B. Delany, South Orange, N. J. Filed May 1, 1907. An automatic dot transmitter comprises a vibrator, an electromagnet therefor, and a key-controlled shunt for the magnet.

989,577. TELEGRAPHY. Patrick B. Delany, South Orange, N. J., assignor to Telepost Co., New York, N. Y. Filed August 24, 1910. In parallel with an electromagnet are a resistance and a chemical recorder.

989,583. APPARATUS FOR TRANSMITTING POWER. James Dunlop, Dennistoun, Glasgow, Scotland. Filed July 5, 1910. A multiple-cylinder air compressor has pilot valves to govern its isolating and atmospheric valves and pressure-controlled electrical means for actuating the pilot valves.

989,584. ELECTRIC CONTROL FOR ELEVATORS. Edward L. Dunn, Worcester, Mass. Filed June 5, 1908. Door switches and limit switches are electrically interlocked with the controller to prevent the movement of the car while any door is open and also to prevent overtravel.

989,588. COOLING DEVICE FOR TELEPHONE-TRANSMITTERS. Carl Emil Egnér, Stockholm, and Johan Gunnar Holmström, Saltjö-Storängen, Sweden. Filed Aug. 18, 1909. A spiral pipe is provided in the vicinity of the diaphragm and contains a cooling liquid passing through the same.

989,596. METHOD OF PROTECTING ARTICLES FROM EARTH-CURRENTS. Hermann Geppert, Karlsruhe, Germany. Filed Feb. 24, 1909. In a ground-return electric railway system the underground piping, etc., is protected from electrolysis by being connected to the negative side of an auxiliary source, whose positive side is connected to a supplementary conductor adjacent the pipes.

989,609. REGULATING MEANS FOR ELECTRIC MOTORS. Coloman de Kandó, Budapest, Austria-Hungary, assignor to George Westinghouse, Pittsburg, Pa. Filed Sept. 26, 1907. Renewed July 26, 1909. Combined with a number of electric motors, and means for regulating their speeds, are means whereby the current supplied to one of the motors, after attaining full speed, effects regulation of the amounts of current supplied to the remaining motors.

989,610. ELECTRIC-VEHICLE-MOTOR SUSPENSION. Kalman von Kandó, Vado Ligure, Italy, assignor to George Westinghouse. Filed May 4, 1908. Comprises a spring cradle in the side walls of the electric locomotive which supports the stator and has bearings for the rotor, also inner bearings for keeping the two parts of the motor concentric. The rotor shaft is connected by side cranks to the drivers.

989,618. PENDANT SNAP-SWITCH. Robert E. Leve, New York, N. Y. Filed April 6, 1910. Has a reciprocating push-button which gives the switch blade a hammer blow.

989,623. LAMP-SOCKET. Norman Marshall, Newton, Mass., assignor to Arrow Electric Co., Hartford, Conn. Filed Oct. 19, 1908. A keyed socket has a number of latching devices engaged by relative axial movement of the cap and shell.

989,626. TROLLEY-HEAD. James F. McKinzie, La Salle, Ill. Filed Jan. 15, 1910. Relates to the construction of the bearings for a ball-bearing trolley wheel.

989,659. MAGNETIC TACHOMETER. John K. Stewart, Chicago, Ill. Filed March 29, 1909. Combined with a permanent magnet and an armature mounted for relative rotation is a low-resistance disk positioned between the magnet and armature and mounted for oscillation about the axis of rotation of the rotating element; means for yieldingly resisting such oscillation, the magnet being mounted for movement radially with respect to the axis of rotation; and means for adjusting it radially.

989,671. ELECTRIC FURNACE. August Voelker, Beuel, near Bonn, Germany. Filed Aug. 13, 1909. A closed hearth has a pendant prismatic pole secured to its cover and a movable pole normally closing the bottom of the hearth.

989,687. SELF-STARTER. Thomas E. Barnum, Milwaukee, Wis., assignor to Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Filed March 14, 1907. Renewed July 14, 1909. A starting rheostat for motors has an electromagnet with two plungers, one operating the contact arm and the other opening the main switch on occurrence of overload.

989,698. ARC-LAMP. William F. Davis, Grand Rapids, Mich., assignor to R. G. Peters Manufacturing Co., Grand Rapids, Mich. Filed April 20, 1909. Comprises a pair of coaxial carbon holders and automatic means for feeding the carbons together.

989,711. ELECTRICAL MEASURING INSTALLATION. Bertrand G. Jamieson, Chicago, Ill. Filed Feb. 14, 1908. A switch for connecting either of two circuits to a measuring instrument.

989,730. ELECTRIC TRACK-SWITCH. Joseph Patrick Tierney, Booterstown, and John Malone, Phibsboro, Ireland. Filed Jan. 31, 1910. An electromagnet is pivoted so that it can operate the tongue of the switch.

989,735. IMPLEMENT FOR MANIPULATING AND MOUNTING FILAMENTS OF ELECTRIC INCANDESCENT LAMPS. Paul Gabriel Triquet, Paris, France, assignor to Societe Anonyme des Perfectionnements aux Lampes Electriques à Filaments Metalliques, Brussels, Belgium. Filed June 17, 1908. Consists of a tube connected at one end to a vacuum pump, through a flexible duct, and having a slotted head at the other end.

989,738. BATTERY-HOLDER. George Newcomb Waterbury, Jr., Washington, D. C. Filed Jan. 14, 1910. Consists of a frame for holding dry cells and provided with spring contacts for connecting the cells together by contacting with the zinc and carbon terminals.

989,761. TELEPHONE LOCK AND CALL-REGISTER. Emanuel L. Buxbaum, Chicago, Ill. Filed May 17, 1909. Mounted on the stem of a desk telephone is a casing containing a locking bar engaging the switch-hook, a register for recording calls and a device for releasing the lock and actuating the register.

989,762. SYSTEM FOR REGISTERING CALLS AND LOCKING TELEPHONES. Emanuel L. Buxbaum, Chicago, Ill. Filed Dec. 2, 1909. Includes a device such as that described in the preceding patent, another register at the exchange, and an electromagnetic device at each register to actuate both simultaneously when the locking bar is in one of the lock-releasing positions.

989,763. SYSTEM FOR REGISTERING TELEPHONE-CALLS. Emanuel L. Bauxbaum, Chicago, Ill. Filed Aug. 5, 1910. Covers the electric controlling system that governs the actuation of both the local and exchange registers referred to above.

989,768. TELEPHONE SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor to Western Electric Co., New York, N. Y. Filed Feb. 21, 1902. Relates to the arrangement of the line and supervisory lamp circuits.

989,791. APPARATUS FOR INSULATING. Max Meirowsky, Cologne-Ehrenfeld, Germany. Filed Oct. 19, 1910. Comprises a rotatable core, heating rolls, and an endless band engaging the core and rolls.

989,792. TELEGRAPH-RELAY. Zantzinger McDonald Miller, Pittsburg, Pa., assignor to Premier Relay Co., Pittsburg, Pa. Filed Sept. 8, 1904. Renewed Nov. 9, 1905. Includes a pair of oppositely wound electromagnets having tubular cores in axial alinement and an armature located in proximity to the adjacent poles of the magnets and pivoted upon an axis parallel to the axes of the cores.

989,798. ELECTRIC MOTOR. George H. Pfeil, Swissvale, Pa., assignor to Union Switch & Signal Co., Swissvale, Pa. Filed Feb. 4, 1910. An insulating bushing for a commutator, comprises two sections adapted to overlap at their meeting edges, each section having a sleeve portion and an inwardly inclined end flange adapted to retain the commutator segments.

989,799. ELECTRIC SIGNALING APPARATUS. Edwin Pope, Quebec, Quebec, Canada. Filed Feb. 26, 1909. Includes electrically controlled contact selectors and a clock-train mechanism for moving all the selectors synchronously.

989,802. ART OF EXTRACTING METALS, SUCH AS GOLD, SILVER, COPPER OR NICKEL, FROM THEIR NATIVE ORES. William D. Rennie, Hackensack, N. J., assignor to Universal Ore Reduction Co., Phoenix, Ariz. Filed April 19, 1910. Consists in subjecting a mixture containing water, a powder of the ore and fluor-spar to electrolytic action until substantially all of the metal is deposited on the cathode of the cell.

989,803 and 989,804. MIXTURE OR COMPOSITION FOR USE IN THE ART OF EXTRACTING THE PRECIOUS METALS, GOLD AND SILVER, FROM THEIR NATIVE ORES. William D. Rennie, Hackensack, N. J., assignor to Universal Ore Reduction Co., Phoenix, Ariz. Filed April 19, 1910. The mixture, according to the first patent, consists of water 2,000 pounds, powdered ore 2,000 pounds, fluor-spar 300 pounds and bromine salt 15 pounds. According to the same patent, there is added to the preceding mixture 5 pounds of cyanide of potassium, all being mixed in the order enumerated and while under the influence of an electric current.

989,814. AUXILIARY TELEPHONE-RECEIVER. Wilhelm Schwarzhaupt, Cologne, Germany. Filed June 15, 1910. A tube leads from opposite the diaphragm of the main receiver to an auxiliary receiver for the other ear.

989,845. ATTACHMENT FOR INCANDESCENT-LAMP SOCKETS. Leonard H. Harding, Brooklyn, N. Y. Filed Sept. 6, 1910. Consists of an extended collar around the socket, to which is pivoted a bell-crank lever that is actuated by a pull cord for operating a spring key.

989,847. AUTOMATIC REVERSING STARTER. Julius Höfle, Budapest, Austria-Hungary. Filed Oct. 24, 1910. Comprises a change-over switch revoluble in opposite directions, a pivoted resistance switch, a pivoted lever between the resistance switch and change-over switch to operate the former, and a series switch mechanically controlled by the resistance switch.

989,853. ADJUSTABLE HOLDER FOR INSULATING-LOOMS. Edward H. Kruse, Fort Wayne, Ind. Filed Oct. 8, 1909. A holder for insulating looms for electric wires, consists of a loosely mounted adjusting screw and a rotary conical wedging member mounted thereon by a screw threaded connection.

989,854. ADJUSTABLE SWITCH-BOX. Edward H. Kruse, Fort Wayne, Ind. Filed Oct. 14, 1909. Comprises a pair of oppositely arranged brackets between which the box is adjustably mounted, and adjusting screws loosely mounted in the inner face of the box and having a screw threaded connection with the brackets.

989,856. TELEPHONE. William C. Lockwood, San Juan, Porto Rico. Filed Jan. 29, 1909. Renewed April 22, 1910. Comprises a receiver provided with an induction coil having a double primary and a single secondary winding, means for maintaining a closed local circuit through one of the primaries, a transmitter circuit connected to the other primary and line wires connected to the secondary winding.

989,892. APPARATUS FOR GENERATING ELECTRICITY. Edward C. Brice and Richard N. Hudson, Lexington, Ky. Filed March 29, 1910. A jar containing a porous cup has a carbon conductor receptacle suspended therein. A porous cup provided with a cover is contained inside the carbon conductor. A metallic conductor consisting of a vertical solid body resting on the bottom of said thin porous cup has a projection at its upper end extending through the cover of the cup, and leading wires are detachably connected with the projection.

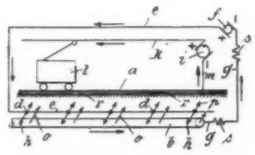
989,905. IGNITION DEVICE. Frank A. Glasgow, St. Louis, Mo. Filed Feb. 17, 1910. Comprises an approximately tubular-shaped member stationarily mounted in the wall of an engine cylinder and provided with an end wall that is arranged inside of the cylinder.

989,923. COMPRESSED-GAS GENERATOR. Heinrich Parzeiler, Essen-on-the-Ruhr, Germany. Filed Nov. 2, 1908. Comprises an explosion-chamber, an inlet pipe for conducting an explosive mixture to the explosion-chamber, an admission-valve in the pipe, a sparking device in the explosion chamber, and an operative connection between valve and sparking device whereby the device is caused to spark when the valve is closed.

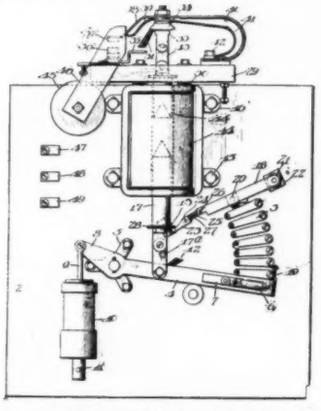
989,924. MAGNETIC SPARK-PLUG. Frederic S. Perrin, Brooklyn, N. Y. Filed Nov. 3, 1910. Is provided with a magnet having a core containing an insulated conductor, a terminal, an armature adapted to rest upon the terminal and provided with an opening adapted to play freely upon and make contact with the conductor.

989,929. FIRE-DAMP INDICATOR. Friedrich Heinrich Schröder and Heinrich Becker, Recklinghausen, Germany. Filed Nov. 16, 1910. A case containing a mixture of kieselguhr, asbestos fibre and spongy platinum is provided with electric wires connecting with a battery and an instrument indicating change of resistance. As heat is generated by fire-damp coming in contact with the spongy platinum the fact is made known by the indicating instrument.

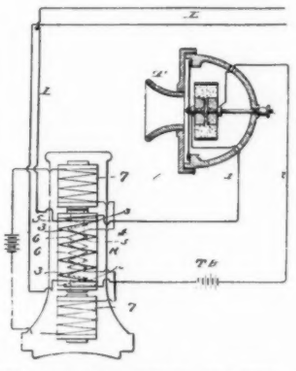
989,944. ELECTRICAL HOOP. Paul Bramson, Chicago, Ill. Filed Nov. 25, 1910. A channel is provided with openings which register with openings in a similar channel. Electric lamps operated by a small battery are placed between the openings and a switch is arranged so that the lamps may be turned on or off.



989,596.—PREVENTION OF ELECTROLYSIS.



989,687.—AUTOMATIC MOTOR STARTER.



989,856.—TELEPHONE SYSTEM.

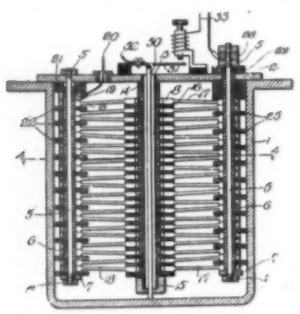
989,970. ANNUNCIATOR. Charles J. Henschel, New York, N. Y., assignor to Charles Cory & Son, New York, N. Y. Filed Aug. 7, 1908. Parallel bars in a casing carry brackets made in U shape and extending from one bar to the next. An annunciator-drop mechanism carried by each of the brackets is located partly at the front and partly at the rear of the brackets.

990,032. ELECTRICAL RELAY. Edward E. Clement, Washington, D. C., assignor to North Electric Co., Cleveland, O. Filed Dec. 23, 1905. A pair of electromagnets united at the rear end is provided with a bent armature pivoted on the angle of a supporting yoke and having a depending portion extending in front of and across the ends of the cores, and a horizontal portion extending over the tops of the magnet spools, and a plurality of contact springs secured upon the rear yoke of the electromagnets.

990,040. IMPROVING THE CONDUCTIVITY AND TENSILE STRENGTH OF COPPER AND ITS ALLOYS. Rudolf Franke, Eisleben, Germany, assignor to Elektrochemische Werke, Berlin, Germany. Filed April 4, 1910. A process of improving copper for the purpose described, which comprises adding calcium in such proportion as to increase the tensile strength and conductivity.

990,069. SEPARATOR FOR STORAGE-BATTERY PLATES. Frank L. Sessions, Columbus, O., assignor to Jeffrey Manufacturing Co. Filed Oct. 8, 1909. Comprises a series of parallel flat strips with openings between, a second series of similar parallel flat strips lying in a plane parallel to that of the first series and separated from it, the strips of one series overlapping those of the other, and connections between the overlapping portions of said strips.

990,103. MAGAZINE ELECTRIC-ARC LAMP. James Brockie, Forest Hill, England. Filed July 22, 1910. The connection between regulating mechanism and magazine comprises a guided link pivotally connected with the regulating lever, a cam slot formed in a suitably shaped part of the link, the lower portion of the slot being in the direction of movement of the link and the upper portion of the slot being inclined toward the magazine with which it coöperates, and a pin attached to said magazine and passing through the cam slot.



990,124.—ELECTRIC HEATER.

990,109. ELECTRICALLY-HEATED WAX-POT FOR SHOE-SEWING MACHINES. Edwin N. Chandler, Brockton, and Theodore B. Lewis, Cambridge, Mass., assignors to Simplex Electric Heating Co., Boston, Mass. Filed March 19, 1909. An electrically operated sectional heater is designed to melt the wax used in a very short time and to keep it melted without raising the temperature to an undue degree.

990,120. ELECTRIC SWITCH-BOX. Mahlon M. Disler, Canton, Ohio. Filed May 25 1910. Has spaced contacts, a resilient bridging contact, a rock shaft on which the bridging contact is mounted, and a slidable device movable transversely to the rock shaft to engage the bridging contact at a point one side of the shaft for moving the same to closed-circuit position.

990,124. ELECTRIC HEATER. Horace B. Gale, Natick, Mass., assignor to Simplex Electric Heating Co., Cambridge, Mass. Original application filed Sept. 19, 1910. Divided and this application filed Dec. 29, 1910. Comprises a resistance conductor formed as a series of conductive sections with radiating arms, insulation separating the sections except at alternate opposite points, and a casing conforming in interior shape to the external form of the sections.

990,158. CONTACT-DISK. Elvard L. Moses, Buffalo, N. Y., assignor to Oxygenator Co., Buffalo, N. Y. Filed Dec. 23, 1909. Comprises a circular body of stamped metal having a central pocket formed with a slightly beveled periphery and a central aperture in the pocket, a surmounting externally screw-threaded stud provided with a small projection at its inner end secured to the central aperture, and having a conical indentation at its outer end, and an internally screw-threaded cap fitting over the screw-threaded stud and having a central wire aperture and a knurled flange.

990,180. BRIDGING-BLOCK FOR DYNAMO-ELECTRIC MACHINES. Frederick Wm. Young, East Orange, N. J., assignor to Crocker-Wheeler Co., Ampere, N. J. Filed Aug. 19, 1908. Consists of a core and a folded sheet iron envelope which extends across one side of the core and is folded over the opposite edges of it.

990,183. RELAY. Charles G. Ashley, Chicago, Ill. Continuation of application filed Jan. 10, 1906. This application filed Nov. 19, 1908. An instrument for increasing the amplitude of wave form current, incluing two windings directly out of inductive relation, for connection in different circuits, and an inductor for and movable with respect to the windings, one winding being in coöperation with the inductor effecting eddy currents in the inductor, which eddy currents are caused to be in primary inductive relation with the other winding.

990,200. RACK FOR ELECTROPLATING DEVICES. William H. Rogers, Muncie, Ind. Filed July 29, 1910. Articles to be electroplated are supported by notched shelves.

990,206. FOOT-WARMING ATTACHMENT FOR ELECTROTHERMAL GARMENTS. Phyllis E. Charles, Portland, Ore. Filed Oct. 12, 1910. Garments wired for the diffusion of electric current are provided with terminal blocks and flexible connections.

REISSUES.

13,227. ELECTRIC-LAMP SOCKET. Gilbert W. Goodridge, Bridgeport, Conn., assignor to Bryant Electric Co., Bridgeport, Conn. Filed Nov. 26, 1909. Original application filed July 18, 1907. Divided and application filed Oct. 26, 1907. Original No. 879,819, dated Feb. 18, 1908. The end of the shell is provided with projections, the cap flange being provided with a greater number of symmetrically arranged openings with any of which the projections in the shell can latch.

PATENTS THAT HAVE EXPIRED.

Following is a record of the electrical patents (issued by the United States patent office) that expired April 24:

518,604. ELECTRICAL CALCULATING SYSTEM. Herman Hollerith, Washington, D. C.

518,613. PROTECTOR FOR ELECTRIC OR OTHER BELLS. Leon R. Lecellier, Viledieu, France.

518,654. ELECTRIC-ARC LAMP. Rudolph Segerdahl, Chicago, Ill.

518,667. ELECTRIC LOCK. James Eldon, Lock Haven, Pa.

518,673. ELECTRICAL DEVICE FOR TOWING VEHICLES. Thomas P. Milligan, South Orange, N. J.

518,693. CONTROLLING-SWITCH FOR ELECTRIC RAILWAYS. Philip Lange, Newark, N. J., and Benjamin G. Lamme, Pittsburg, Pa.

518,695. CONDUIT ELECTRIC RAILWAY. Charles A. Maynard, Springfield, Mass.

518,710. METHOD OF AND APPARATUS FOR ELECTROCHEMICAL DECOMPOSITION. Henry Carmichael, Malden, Mass.

518,711. PRODUCING METALLIC ZINC. Parker C. Choate, New York, N. Y.

518,713. SUPPORT FOR ELECTRIC LIGHTS. William H. Connell, Wilmington, Del.

518,719. ELECTRIC-ARC LAMP. Carl Hoffmann, Berlin, Germany.

518,732. ART OF PRODUCING METALLIC ZINC. Parker C. Choate, New York, N. Y.

518,738. APPARATUS FOR NEUTRALIZING THE EFFECTS OF SELF-INDUCTION IN ALTERNATING-CURRENT CIRCUITS. John F. Kelly and Cummings C. Chesney, Pittsfield, Mass.

518,739. MEANS FOR REDUCING THE APPARENT ENERGY SUPPLIED TO ALTERNATING-CURRENT MAGNETS. John F. Kelly, Pittsfield, Mass.

518,740. ALTERNATING-CURRENT DYNAMO. John F. Kelly, Pittsfield, Mass.

518,742 TELEPHONY. William C. Lockwood, New York, N. Y.

518,756. ARMATURE FOR DYNAMO-ELECTRIC MACHINES OR ELECTRIC MOTORS. Thomas H. Hicks, Detroit, Mich.

518,767. CONDUCTOR-PIPE AND METHOD OF JOINING EDGES OF SAME. William J. Plecker, Peoria, Ill.

518,768. DYNAMO-ELECTRIC MACHINE OR MOTOR. Andrew L. Riker, New York, N. Y.

518,781. ELECTRIC OPERATING MECHANISM FOR VEHICLES. Louis E. Freedley, Boston, Mass.

518,782. DISTRIBUTION SYSTEM FOR ELECTRIC RAILWAYS. James E. Goodhand, Baltimore, Md.

518,786. DIAPHRAGM FOR ELECTROLYTIC CELLS. Ernest A. Le Sueur, Ottawa, Canada.

518,788. ELECTRICAL-INSTRUMENT TABLE. Jacob F. Merren, Chicago, Ill.

518,792. DUPLEX ARC LAMP. Charles E. Scribner, Chicago, Ill.

518,800. ELECTRIC SWITCH. Ernst Woltmann, Chicago, Ill.

518,813. ELECTRIC SWITCH. Warren S. Hill, Hyde Park, Mass.

518,894. ELECTRIC BELT. Per E. Petterson, Minneapolis, Minn.

518,906. AUTOMATIC DEVICE FOR REMOVING RESISTANCE IN STARTING ELECTRIC MOTORS AND REPLACING SAME. George H. Whittingham, Baltimore, Md.

518,907. CLEAT FOR SUPPORTING CONDUCTING WIRES FOR ELECTRIC CIRCUITS. Horace B. Wyman, Slingerlands, N. Y.

518,913. COMMUTATOR BRUSH. George W. Brown, Deering, Me.

518,916. TELEPHONE-TRANSMITTER. Herbert Cottrell, Newark, N. J.